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Bone Changes in Leprosy: A Clinical and Roentgenologic Study of 505 Cases[1]

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IT IS WELL KNOWN that there are two main types of leprosy, the lepromatous (formerly called cutaneous or nodular) and the neural, which differ widely in prognosis, pathology, and clinical manifestations. One of the important differences between the two types of the disease is the kind and extent of bone involvement. The usual and most remarkable bone changes are those of neurotrophic origin, which occur in the majority of neural cases and not in true lepromatous or nodular leprosy. Of an entirely different nature is the rarer and less conspicuous type of bone destruction seen in the lepromatous type of the disease. Most cases of neural and lepromatous leprosy sooner or later acquire lesions of the other type and thus become the mixed type, in which bone changes of both varieties occur.

From a review of the literature it appears that little has been written on the subject in the last fifteen years. The two outstanding contributions within that period are those of Chamberlain, Wayson, and Garland (1931) and Murdock and Hutter (1932). Most of the bone changes seen by us have been described by other writers, but these have not reported such extensive bone destruction or made clear that certain bone changes correspond to certain types of the disease. Honeij (1917), for example, reported similar bone involvement in all types of leprosy, with bone absorption found as frequently in the nodular (lepromatous) type as in the neural. As long ago as 1911, Dyer and Hopkins, in Louisiana, were impressed by finding necrosis, atrophy, and absorption of digital bones confined practically exclusively to neural leprosy. This experience has continued unchanged at the National Leprosarium in the intercurrent years.

Before reporting upon our findings it may be well to emphasize the fact that, since the usual bone changes occurring in leprosy are neurogenic, they are similar to those found in other neurotrophic diseases. For example, atrophic absorption of the phalanges has been found in Raynaud's disease, syringomyelia, tabes dorsalis, and chronic injuries of the spinal cord or of the peripheral nerves. Furthermore, other diseases may produce bone lesions similar to those of leprosy, as, for example, osteomyelitis, diabetic gangrene,

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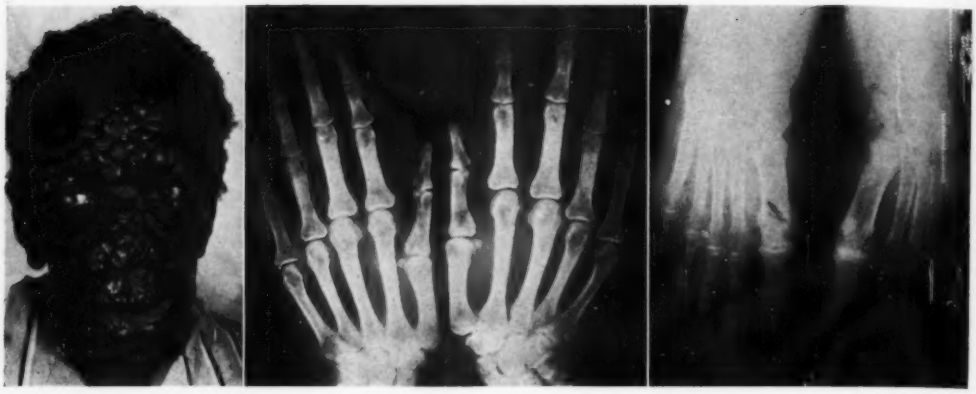

Fig. 1. Lepromatous leprosy of fifteen years' duration in a colored female, American, 42 years of age, showing leonine facies, leprous keratitis, and corneal opacities. Upper and lower limbs are also covered by extensive lepromatous nodulation and infiltration. There is no x-ray evidence of bone changes in hands or feet, the usual observation in lepromatous cases.

gout, Buerger's disease, scleroderma, psoriasis, ainhum, frostbite, Boeck's sarcoid, tuberculosis, and syphilis. In addition, tabes may produce Charcot joints which occasionally involve the smaller articulations of the hands and feet with contractures which are indistinguishable from those of leprosy.

The present study is based upon the observation of 505 patients with all types of leprosy at the National Leprosarium. Of this number 340 were males and 165 females, a proportion of over 2 to 1. The ages on admission to the leprosarium varied from four to seventy-six years. The majority of the patients were between twenty and forty-five years of age.

The period of observation varied from several months to two and a half years; all patients in the leprosarium between July 1940 and January 1943 were included. The classification of the disease in the group under study is indicated in Table I: 47.7 per cent of the cases were of the mixed type, 31.7 per cent of the lepromatous type, 18.2 per cent of the neural type, and 2.4 per cent of the tuberculoid type. The table also gives the incidence of bone changes, as demonstrable roentgenographically, encountered in each type of the disease, as well as muscular atrophy and contracture of digits.

TABLE I: INCIDENCE OF BONE AND MUSCLE CHANGES IN LEPROSY

Types of Disease	Number of Cases	X-ray Bone Changes	Muscular Atrophy and Contracted Digits
Mixed type	241	79	66
Lepromatous type	160	9	0
Neural type	92	59	26
Tuberculoid type	12	0	1
Total	505	147	93

Bone changes of varying degrees were seen in roentgenograms of the hands or feet, or both, of 147 of the 505 patients, an incidence of 29 per cent. Bone changes occurred in only 9 of the 160 lepromatous cases, or 5.6 per cent. Fifty-nine of the neural cases showed definite bone lesions, which in many cases were extensive and of a mutilating nature. This is an incidence of 64 per cent for this form of the disease. Finally, of the 241 mixed cases, 79 or 33 per cent, showed bone involvement.

In addition, clinically and roentgenologically, it was found that 93 patients suffered from more or less muscular atrophy and digital contraction, in the extreme cases producing claw-hands and claw-feet. Although the majority of these patients had a combination of both neurotrophic and motor disabilities of the extremities,

many exhibited either bone absorption or muscular paralysis and contracture alone (Figs. 9 and 10). This exclusive involvement of either the motor or the neurotrophic nerve fibers in leprosy has not been reported elsewhere to the authors' knowledge. Hopkins (1928), it is true, observed in this institution that "the claw-hand of leprosy is a result of atrophy and contracture of the flexion mechanism, most marked when loss of bone is inconsiderable." It can now be added that the opposite is equally true, that bone absorption is most marked when atrophy and contracture are inconsiderable.

Patients with claw-hands, muscular atrophy, and ankylosis of interphalangeal joints may be so disabled as to be dependent upon others to feed and dress them. Conversely, patients with extensive bone absorption of the fingers and little or no muscular atrophy have the function of the hands partially preserved. These patients are often able to feed themselves, dress, write, and perform other delicate manual tasks with only remnant stubs for fingers. This phenomenon is not easily explained but is probably dependent upon an unequal involvement of the neurotrophic and motor neurones. When the neurotrophic neurones are primarily attacked, the motor neurones seem to escape, and trauma to active fingers enhances bone absorption. When the motor neurones are principally involved, muscular atrophy and contractures protect immobile fingers from bone absorption.

Fig. 2. Lepromatous leprosy of six years' duration in a male, Chinese, 64 years of age. Enlarged nutrient canals are seen in several phalanges.
Fig. 3. Lepromatous leprosy of four years' duration in colored male, American, 34 years of age. There is a small cyst of the shaft of the proximal phalanx of the ring finger.

LEPROMATOUS LEPROSY

Lepromatous leprosy even in its advanced stage is usually free from bone lesions (Fig. 1). In our experience bone disease, if it does occur, is limited in extent and of little clinical significance. It is entirely different from the osseous absorption of neural leprosy. In the 9 lepromatous cases in our series in which bone disease was found, it consisted of enlarged nutrient canals in 4, cyst formation in 3, necrosis or osteomyelitis in 1, and periostitis in 1 (Figs. 2–5).

Fig. 4. Lepromatous leprosy of five years' duration in white male, American, 22 years of age. Note multiple cysts in phalanges and metacarpals of both hands. Smears made of material aspirated from a cyst show numerous acid-fast bacteria including many globi.

Fig. 5. Lepromatous leprosy, later becoming mixed, of seventeen years' duration in a male, Hawaiian, 22 years of age. A. Lepromatous stage: periostitis and osteomyelitis, presumably leprous in origin, of the proximal phalanx of ring finger. There are also enlarged nutrient canals. B. Mixed stage, seven years later. Healing has been complete with little residual evidence of bone destruction. Notice beginning neurotrophic absorption of tuft of little finger.

The enlarged nutrient canals are considered to be produced by a leprous infection of the nutrient vessels. Necrosis of bone is believed to result from interference with the blood circulation due to a leprous endarteritis. It is primarily an aseptic necrosis. Fite (1941) reports the frequency of involvement of blood vessels in lepromatous leprosy. The endothelium is commonly infected, and a lepromatous growth into the lumen of a small vessel may be produced (Fig. 19). This condition may well lead to vascular occlusion with resultant necrosis.

NEURAL LEPROSY

The most important bone changes of leprosy are those found in neural leprosy. They are not due to the direct action of Hansen bacilli on the bones but to a remote nerve infection which causes secondary bone absorption of a neurotrophic nature. Hansen bacilli are rarely, if ever, encountered in the bone marrow of neural cases. Gass and Rishi (1934) found bone marrow smears negative for these organisms in 100 per cent of 48 neural cases, whereas 17 of 21 lepromatous cases gave positive findings.

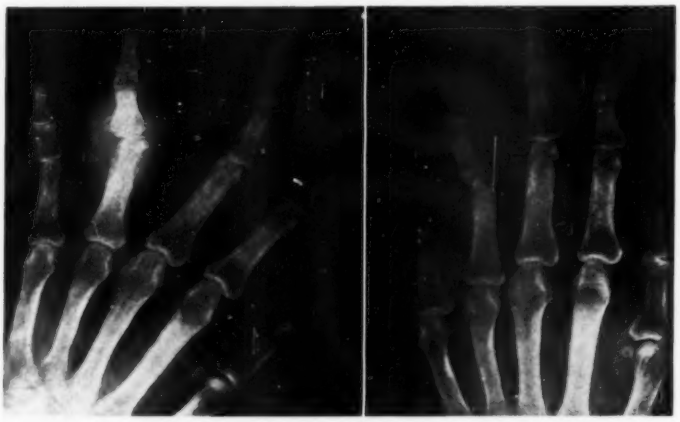

Fig. 6. Mixed leprosy of seven years' duration in male, Filipino, 42 years of age. The roentgenogram on the left shows osteomyelitis of the proximal phalanx of the ring finger, believed to be of leprous origin. Ten months later (right) there was complete healing, with little osseous destruction.

Bone cysts are considered to be due to the direct action of Hansen bacilli infecting the medullary cavity. Needle puncture and aspiration of the cysts yield material rich in acid-fast bacilli and globi. These have been discovered, also, in bone marrow smears taken at necropsies from a large percentage of such cases at the National Leprosarium. It is conceivable that they multiply there to form lepromata. Occasionally these lepromata may grow sufficiently large to appear in roentgenograms as bone cysts. Direct infection with *Mycobacterium leprae* is probably responsible for some cases of osteomyelitis and periostitis.

The neurotrophic bone changes of nerve leprosy are found to consist of a slow and insensitive bone absorption. This spontaneous absorption of bone thins out or shortens the phalanges, metacarpals, and metatarsals. In the hands the process generally starts in the distal phalanges, causing slicing and nicking of the tufts, then a shortening of collar-button type, followed by gradual disappearance (Figs. 7 and 8). Next the middle phalanges are attacked. The bones seem to melt away, the proximal phalanges being the last to disappear (Fig. 10). In rare cases even the metacarpals are attacked, but the process seldom ascends higher (Fig. 11).

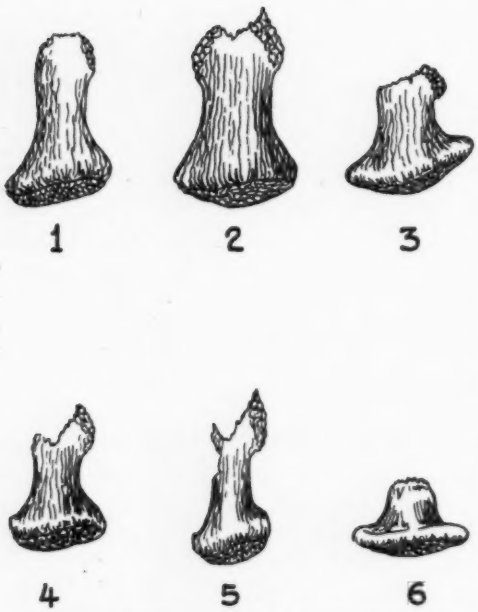

Fig. 7. Tracings of distal phalanges from neural and mixed cases, showing earliest types of bone absorption in the form of slicing and nicking and collar-button formation.

In the feet the absorptive process is apt to start in the shafts of the proximal phalanges or in the heads of the metatarsals (Figs. 14 and 15). The diaphyses of the phalanges become gradually thinned by the rarefying osteitis, so that eventually there is but a fine needle of bone left (Fig. 15). This condition of gradual erosion of the cortical portion of the bones has been aptly called a "concentric bone atrophy." During this process the medullary cavity disappears or becomes calcified. A complete disappearance of the involved bone is a frequent final outcome. In such cases the shortened toes are seen to override the shortened foot (Figs. 16 and 18). These toes are loosely connected to the foot by soft tissue only, but may still contain the two distal phalangeal bones. Spontaneous fractures are frequent, due to the trauma of weight-bearing on the insensitive diseased bones.

The metatarsal bones, unlike the metacarpals, are commonly involved beginning at their distal ends. During the process of absorption, these bones become shortened, while their distal ends become pointed. The appearance produced can be likened to that of a stick of candy being sucked away (Figs. 15 and 18). The process rarely extends higher than the metatarsals, the tarsal bones and the lower ends of the tibia and fibula usually remaining intact.

The difference in the mode of onset of bone absorption in the hands and feet shows the importance of trauma as a contributing factor. In the hands the point of greatest stress and the site of the most repeated traumas is at the ends of the fingers. Constantly repeated strain is applied to the finger tips in touching, feeling, and grasping objects in one's environment. The prime function of the feet being weight-bearing, it is the ball of the foot which sustains the greatest pressure and traumas. It is not surprising, therefore, that it is the tips of the distal phalanges in the hands and the heads of the metatarsals and the diaphyses of the proximal phalanges in the feet which first undergo neuro-leprous bone degeneration and absorption.

In claw-hands the finger tips are protected from trauma, but the flexed interphalangeal joints are frequently bumped against hard objects. Roentgenograms of claw-hands show the effects of such trauma in frayed joint surfaces, erosions of articulating ends, mushrooming of the phalangeal bases, chipped-fractures into joints, and other evidence of destructive arthritis (Fig. 12). The ankylosis of claw-hands occurs principally in the interphalangeal joints, while the metacarpophalangeal articulations usually remain free and active.

Although larger joints remain comparatively free in neural leprosy, there may be either a fibrous or a bony ankylosis of the interphalangeal or the metacarpophalangeal and metatarsophalangeal articulations, or an abnormal relaxation of the joints (Fig. 14). Subluxations are not uncommon, especially in the feet. Painless disorganizing arthropathies are frequent in small joints (Fig. 14) and are not entirely wanting in the larger joints. We

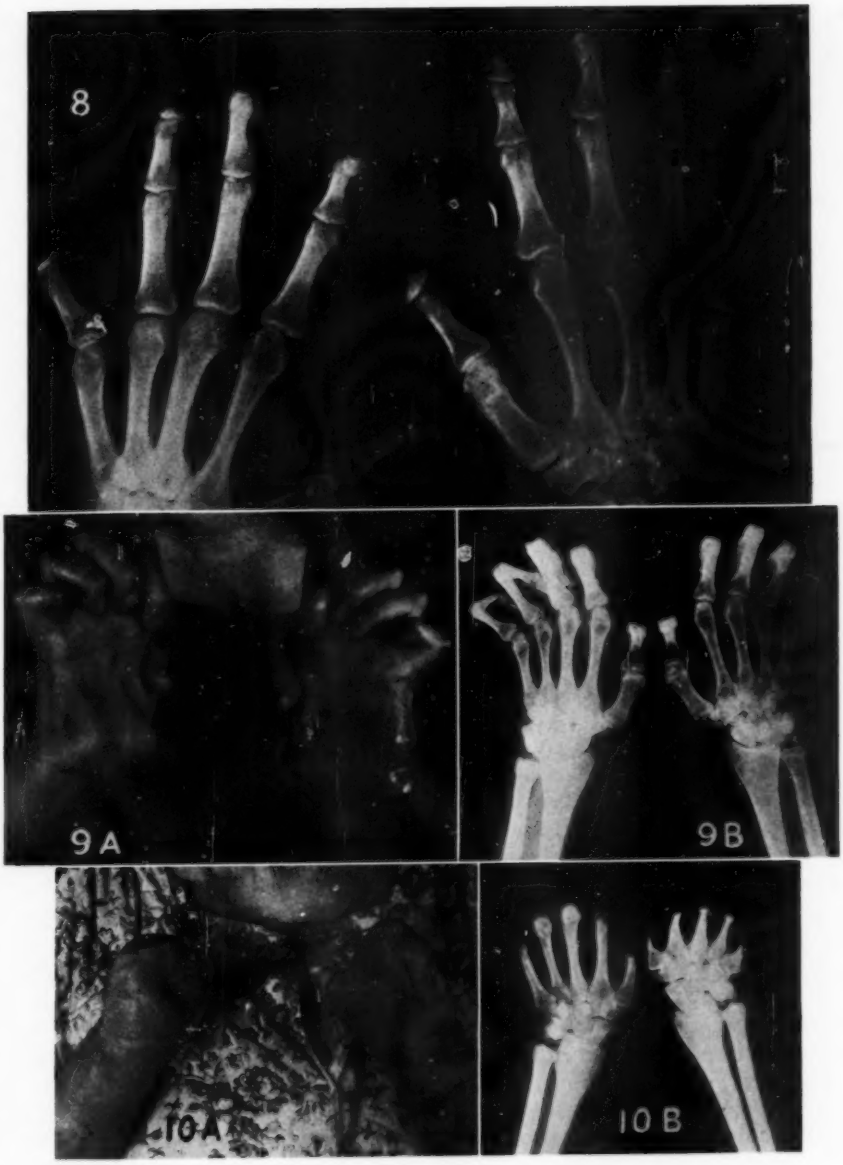

Fig. 8. Neural leprosy of fourteen years' duration in white male, Mexican, 26 years of age. Early bone absorption in hands. Different stages of bone absorption limited to distal phalanges, from slight absorption of tufts to almost complete absorption of distal phalanx.

Fig. 9. Neural leprosy of nine years' duration in white female, American, 37 years of age. Extreme clawing of hands and muscular atrophy with very little bone absorption. There is great crippling of function.

Fig. 10. Neural leprosy of forty-one years' duration in white female, American, 60 years of age. Note almost complete absorption of phalanges and partial absorption of metacarpals. No muscular atrophy and some preservation of function of hands. Contrast with Figs. 9 and 12.

Fig. 11. Neural leprosy of thirty years' duration in white female, American, 53 years of age. Remarkable spontaneous absorption of bones of hands (mutilating leprosy). There have been no amputations in this case.
Fig. 12. Mixed leprosy of thirteen years' duration in white female, American, 38 years of age. Claw-hands with minimal bone absorption, showing destructive arthritis of interphalangeal joints and fracture of head of metacarpal. This is the result of trauma to crippled, insensitive hands.

have observed five typical Charcot joints of wrists and ankles in our cases, where syphilis could be excluded clinically and serologically (Fig. 13).

MIXED LEPROSY

The bone lesions of mixed cases partake of the nature of both the neural and lepromatous types. Of the bone changes in the 79 mixed cases the great majority were of neurotrophic type; only 25 showed osseous infection of lepromatous origin. The lepromatous type of bone involvement is more frequent in mixed than in lepromatous cases, since it is generally a late manifestation of leprosy. In the 25 cases in this series there were cystic degeneration, osteomyelitis, periostitis, enlarged nutrient canals, and occasionally a spindle-shaped leprous dactylitis closely simulating that of tuberculosis or syphilis (Figs. 6 and 17). The neurotrophic bone lesions, especially in advanced cases, are often extensive and mutilating (Fig. 16).

EXPLANATION OF NEUROTROPHIC BONE CHANGES

The exact causative factor of bone absorption in neurotrophic leprosy is not proved. It is considered to be the result of disturbance of the nutritional function of the affected nerves rather than of a faulty calcium and phosphorus metabolism.

In an earlier study at the National Leprosarium, Lemann, Liles, and Johansen (1927) analyzed the blood of 54 patients for calcium content and concluded that this bears no relationship to bone absorption in leprosy. Wooley and Ross (1931) confirm the findings of others that bone changes in leprosy are not dependent on total blood calcium. In their experience the calcium-phosphorus balance ratio also failed to explain these bone deficiencies. The average diffusible calcium was found to be lower, however, in patients with leprosy than in normal adult controls. These workers conclude that there may be a possible relationship between low diffusible calcium content of the blood and decalcification and bone absorption in leprosy.

In our experience a leprous neuritis must be of sufficiently long duration and of an advanced stage, with degeneration and fibrosis of nerve fibers, before bone absorption takes place. We have seen repeated neural and mixed cases of several years'

duration with little or no bone change; we have not seen the rapidly developing and receding bone changes in youths reported elsewhere. It is true that our young population is proportionately small. Muscular atrophy and contractures of digits generally precede and often are present for several years before the onset of bone absorption in cases where the two conditions are combined.

Thus bone absorption in leprosy in our experience is a relatively late manifestation of the neural or mixed type of the disease. It does not occur in the purely nodular, cutaneous, or lepromatous type, where the nerve trunks are not affected. As a late manifestation it is always accompanied by other distinctive signs of neural leprosy. This fact is important from a differential diagnostic standpoint, since the early roentgenologic findings in the hands and feet are not so characteristic of neural leprosy as to be easily distinguishable from bone changes of other neurotrophic diseases of either the central or peripheral nervous system. The mutilating bone changes of advanced neuroleprosy are characteristic but of no special value in diagnosis, since the clinical manifestations then present offer no diagnostic difficulties.

Fig. 13. Mixed leprosy of twenty years' duration in colored male, American, 36 years of age. Charcot wrist in a patient in whom syphilis was ruled out by history, clinical findings, and negative blood and cerebrospinal fluid serology. Note extensive neuroleprous absorption of phalanges.

SECONDARY INFECTION

In such a chronic disease as leprosy it is not surprising that secondary infection sooner or later supervenes to cloud the clinical and roentgenologic picture. Bone lesions due to secondary infection are common in all types of leprosy and are most frequent in the mixed type. Long-standing lepromatous or trophic ulcerations of the extremities offer a convenient portal of entry for pyogenic organisms, leading to the production of secondary osteomyelitis. Although it is our experience that chronic osteomyelitis in leprosy may be initiated by Hansen's bacillus, contamination by pyogenic invaders is the rule. We have found Hansen's bacillus in smears taken from osteomyelitic bones, even in neural cases, which shows its importance in such bone disease. Even when secondary invaders play a major role in the destructive process, it is felt that *Mycobacterium leprae* exerts a modifying influence on the osteomyelitis.

In roentgenograms seen side by side, lepromatous osteomyelitis is difficult to differentiate from pyogenic osteomyelitis. The rate of bone destruction is an important distinguishing point. In the pyogenic variety there is rapid destruction, with no regeneration. In leprous osteomyelitis there is slow evolution, complete necrosis does not always supervene, and there may be regeneration of bone (Figs. 5 and 6).

Involvement of the nasal cartilages is a common late sequence of leprosy of the nasal mucosa. This is a frequent complication of lepromatous and mixed leprosy. The final crumbling of the cartilaginous nasal septum produces the typical saddling deformity of the nose so common in advanced stages of the disease. Disintegration of the bony septum is extremely rare. When it occurs, it is probably caused by

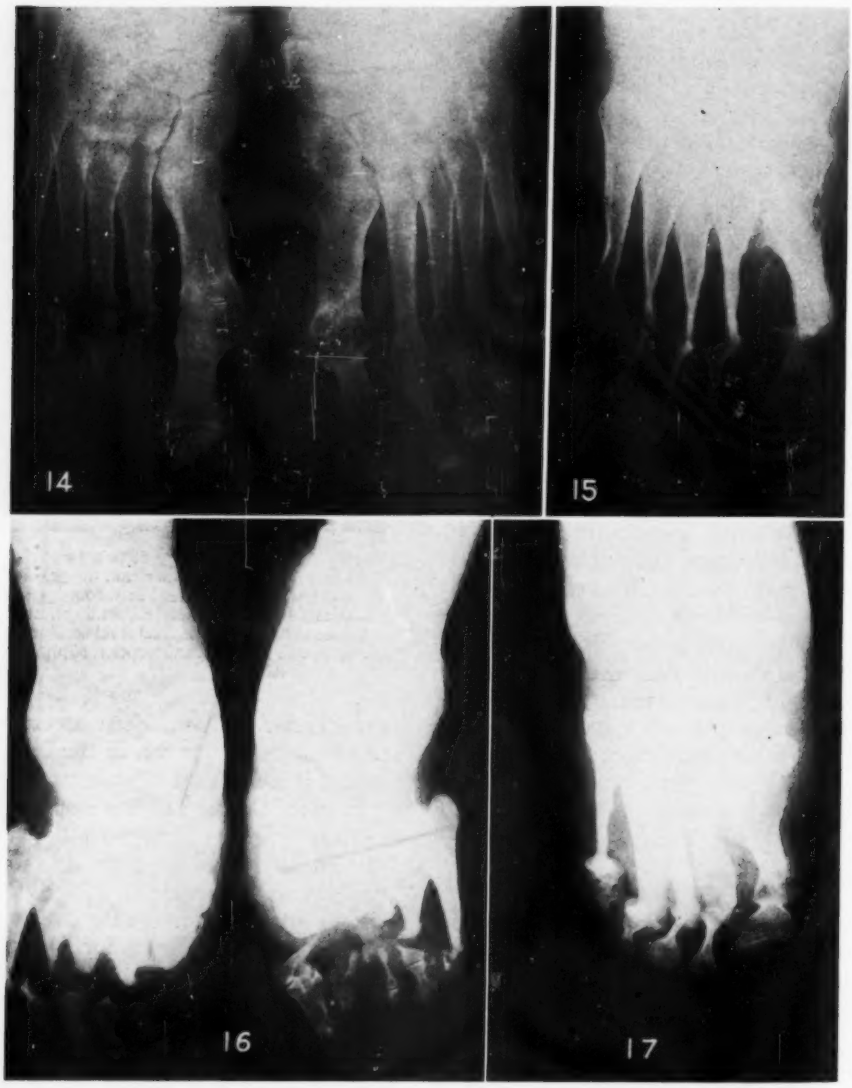

Fig. 14. Mixed leprosy of seventeen years' duration in colored male, Jamaican, 49 years of age. Right foot shows bony ankylosis of metatarsophalangeal joint of big toe, absorption of head of second metatarsal and base of second proximal phalanx, with subluxation and "concentric atrophy" of fourth proximal phalanx. Left foot shows "concentric atrophy," most marked in proximal phalanx of fourth toe. There is disorganizing arthropathy (Charcot joint) of the metatarsophalangeal articulation of the big toe.

Fig. 15. Neural leprosy of twenty-one years' duration in white female, American, 66 years of age. Advanced "concentric atrophy" of phalanges (some as fine as needles). Distal ends of most metatarsals show absorption of the "sucked stick-candy" type. Dislocation of metatarsophalangeal joint of big toe and old healed osteomyelitis of its shaft.

Fig. 16. Mixed leprosy of twenty-three years' duration in colored male, American, 42 years of age. Common mid-zone type of neurotrophic bone absorption with shortening of feet. Notice preservation of middle and distal phalanges in dislocated toes.

Fig. 17. Mixed leprosy of twenty years' duration in white female, American, 41 years of age. Spindle-shaped dactylitis of metatarsals. Different stages of neurotrophic bone absorption of toes.

Fig. 18. Neural leprosy of six years' duration in white male, American, 45 years of age. Note dislocated overriding toes and melting away of metatarsals into distal points.

the destructive activity of secondary pyogenic invaders entering through leprous ulcerations of the nasal mucosa.

ARTERIOGRAMS

In order to confirm or disprove the possible relationship between the vascular supply of the hands and feet and bone destruction in leprosy, we have attempted to study the circulation of the extremities in our cases. X-rays of the hands and feet were taken during life and after death, in all types of the disease, following the injection of radiopaque solutions into the large arteries of the limbs. During life such arteriograms were made following the injection of thorotrast into the femoral and brachial arteries. At necropsy it was found that the best results were obtained through the arterial injection of lipiodol or other iodized oils.

From roentgenograms made after these injections of radiopaque material, very clear pictures of the arterial trees of the hands and feet were produced (Figs. 20 and 21). It is our impression from the study of these films that the arterial circulation of the extremities is not materially disturbed in neural leprosy. There seemed no causal relationship between the arterial supply of the hands and feet as demonstrated in arteriograms and the degree of neurotrophic bone absorption. In advanced

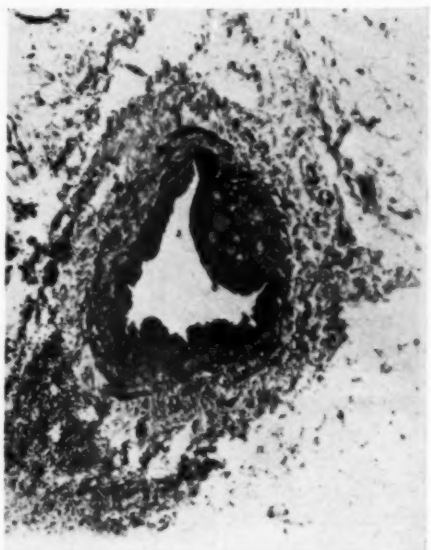

Fig. 19. Leprous endarteritis. Note leproma bulging into lumen of artery. Courtesy of Dr. C. H. Binford, U. S. Public Health Service.

lepromatous and mixed cases, on the other hand, localized arterial defects and decrease in size of arterial branches were found, which suggest the vascular leprous lesions described by Fite and others.

CONCLUSIONS

1. In our experience bone changes in leprosy are for the most part confined to

Fig. 20. Mixed type of leprosy of fifteen years' duration in white female, American, 58 years of age. Postmortem arteriogram of hand following injection of brachial artery with lipiodol.
Fig. 21. Lepromatous leprosy of ten years' duration in white male, Mexican, 37 years of age. Arteriogram made during life by injection of thorotrast into brachial artery. Note defects in some digital branches.

the neural type of infection. In this type they are not the result of direct local action by Hansen's bacilli within the bone but of the distant infection of the nerve trunks and are neurotrophic in nature.

2. Roentgenographically demonstrable bone changes in leprosy are not pathognomonic of this disease, except in advanced stages, but are similar to those of other neurotrophic nerve diseases, whether of central or peripheral origin.

3. The differential diagnosis of leprous bone changes must not be based entirely upon the x-ray findings but must rely upon the other clinical and neurologic manifestations of leprosy, which are not present in simulating diseases.

4. An explanation is advanced for the difference in points of origin of the bone absorption in the hands and in the feet in neural leprosy.

5. The observation is made that in the upper extremities there is frequently either a preponderance of bone absorption with almost complete exclusion of soft tissue involvement or, conversely, extreme muscular atrophy and contractures with little or no bone absorption.

6. A theory is advanced in explanation of this phenomenon, which has not heretofore been completely reported in the literature.

7. Arteriographic studies are interesting but have not thus far been helpful in observation of bone changes in leprosy.

8. Bone lesions in lepromatous leprosy are rare, consisting mostly of cyst formation, osteomyelitis, necrosis, periostitis, and enlargement of nutrient canals.

9. These changes are due to primary involvement of the bone marrow or periosteum by Hansen bacilli or to a vascular leprosy of the supplying arteries.

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Absorptive Bone Changes in Leprosy[1]

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and

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WITH FEW exceptions, the disease leprosy respects no human tissue. The skin may be involved by lesions of various types which can assume the characteristics of syphilis (1), tuberculosis (2), Besnier-Boeck sarcoid (3), and Raynaud's disease (4). Nerve structures are particularly susceptible to attack by the bacillus of leprosy, often with resultant local destruction of the nerve fibers and loss of function of the part. In some cases, osteoid changes occur in the nerve (5). The walls of the blood vessels may be invaded through the vasa vasorum (6), with subsequent inoculation of the parts distal to

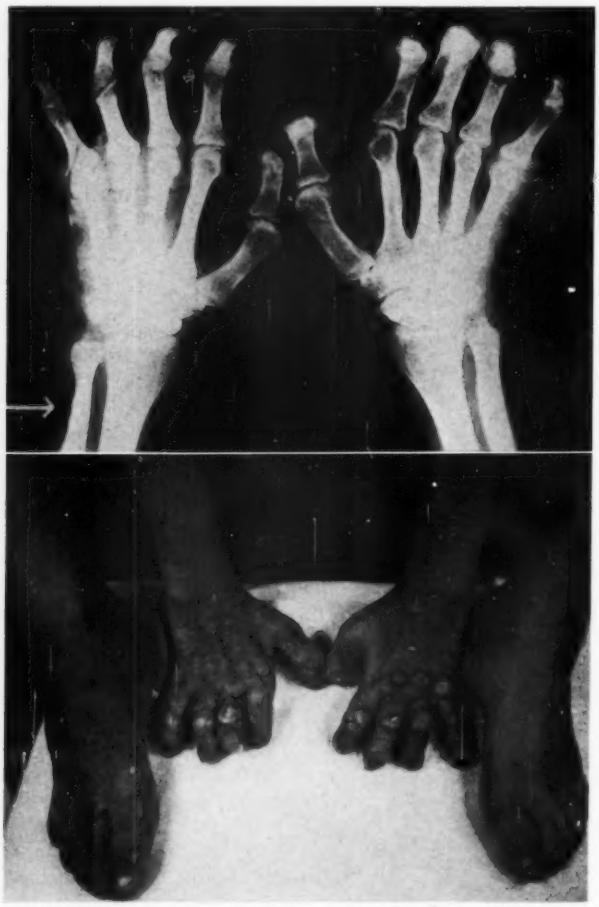

Fig. 1. Pressure erosion due to enlarged ulnar nerve.

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the diseased vessel wall and alteration of the blood flow through the vessel. Tajiri (7) reported finding small leprous foci in the lungs. The bone may be the seat of local leprosy involving the periosteum (8) or the nutrient artery and nerve (9).

Fig. 2. Osteoarthritis with resultant dislocation due to direct extension of contiguous soft-tissue leprosy.

The periosteum and cortex may be completely destroyed by pressure (Fig. 1), direct extension of contiguous soft tissue leprosy (Fig. 2), or by local disease of the nutrient artery and nerve (Figs. 3 and 4). It is the purpose of this paper to present and discuss the phenomenon of complete bone absorption which occurs in the small bones of the hands and feet in lepers.

Absorptive bone changes occur in the phalanges of the hands and in the metatarsal bones of the feet in leprosy. Such changes were described by Murdock and Hutter (9) as minute nicks, slices, frayings, collar buttoning, and grossly prominent nutrient foramina which are demonstrable by roentgen examination and are considered of diagnostic significance. The generalized bone absorption which follows results in a complete loss or lysis of bone

structure (Figs. 5 and 6) and is associated with loss of sensation and muscle power in the hands and the feet due to sensory and motor nerve lesions. Neurocirculatory changes take place so that ulceration occurs at the points where usage causes pressure. While osteomyelitis, osteitis, and arthritis may occur, they are merely coexistent and are not characteristic of leprosy.

Fig. 3. Enlarged nutrient foramina.

Our study of roentgenograms of the hands and feet of lepers demonstrates a point not hitherto mentioned in the literature. The phalanges in the feet are often preserved intact even when there is marked destruction of the metatarsal and tarsal bones (Figs. 5 and 6). In contrast, the absorption of the phalanges of the hands always occurs before the involvement of the metacarpal bones, beginning at the distal end of the distal phalanx. It is felt that this is due to the fact that in the feet it is the heads of the metatarsal bones and in the hands the tips of the carpal phalanges that are subject to the maximum trauma and pressure in ordinary function and use.

Several factors account for the phenomenon of complete bone absorption: altered circulation, anesthesia, and pressure. Roentgenograms of the extremities of lepers clearly show generalized increased density in the areas where bone absorption has not been completed. Normally, when

the circulation to bone is decreased it undergoes consolidation, with increased density and osteosclerosis (10). Our physical examination showed a very strong pulsation in the large arteries of the wrists and ankles, which indicated to us that the general circulation was good or even better than normal. Leitner (11) injected the arterial bed in amputated extremities of lepers and found that the arterial system was present in its entirety. We have roentgen proof of the local involvement of the nutrient artery and nerve in the early enlargement of the nutrient foramina (Fig. 3) and believe that the decrease in circulation is local with each individual bone. Alteration in the circulation alone, however, is not sufficient to account for the complete lysis of bone structure.

Mitsuda and Ogawa (12) found ascending degeneration of the tracts of Goll and Burdach of the posterior spinal column due to a leprotic peripheral neuritis in 68 per cent of neural and 50 per cent of cutaneous cases of leprosy. The leprotic degeneration of the peripheral motor and sensory nerve trunks and the degeneration of the tracts in the spinal cord are the pathological basis for the anesthesias of leprosy and the neurocirculatory disturbances discussed by Vishnevsky (13), who demonstrated considerable improvement in local leprous lesions in the feet after novocain nerve block. This nerve block

Fig. 4. Enlarged nutrient foramina.

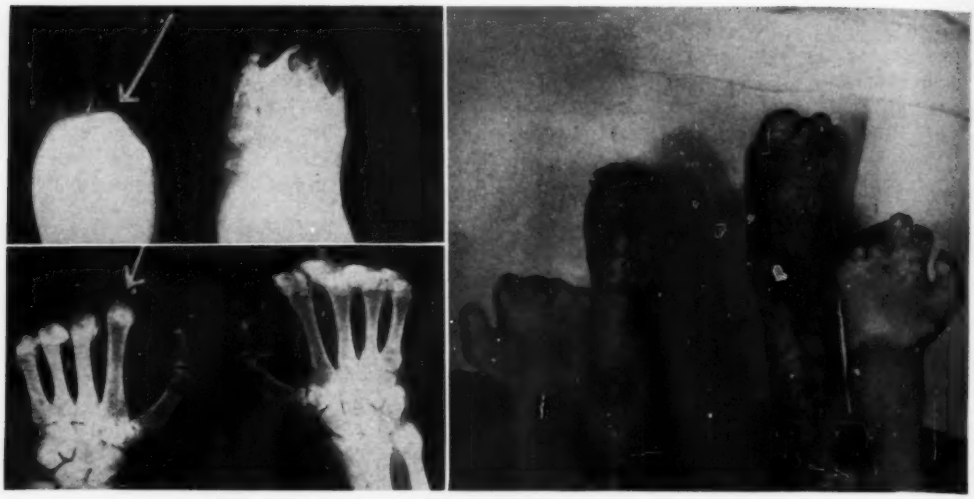

Fig. 5. Complete destruction of metatarsal and tarsal bones of left foot, with intact phalanges. Absorption of phalanges in hand, while metacarpals remain intact.

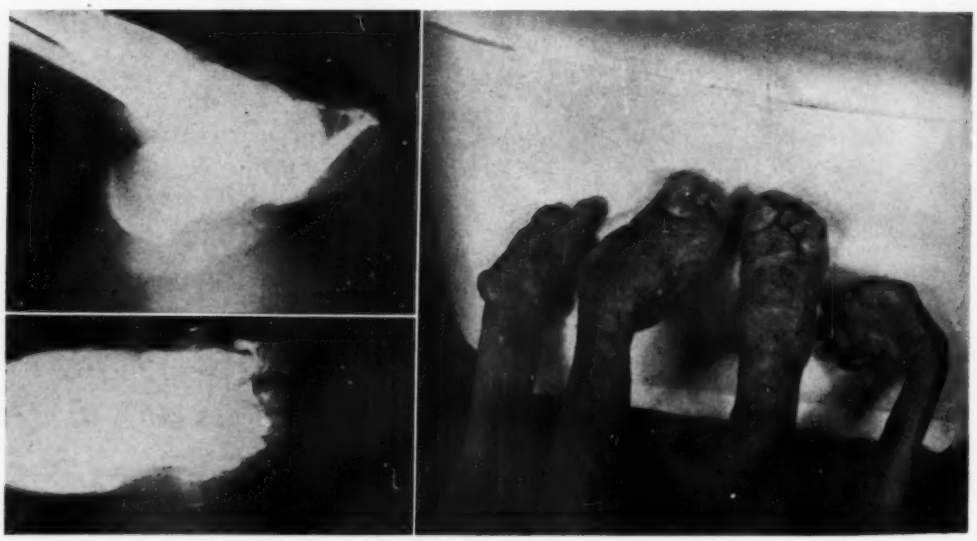

Fig. 6. Severe contracture deformities and generalized lysis of bone structure with persistence of phalanges of feet.

was applied only to the peroneal nerve at the ankle, but it upset the neurocirculatory balance sufficiently to cause long standing ulcers on the feet to heal and remain healed.

Pressure, the third factor in bone absorption, does not cause pain because of anesthesia. Although the bone absorption must proceed through the circulation, the active force of pressure is necessary to complete the process. Figure 1 shows the phenomenon of bone lysis taking place at the lower end of the ulna at the site of a leproma of the ulnar nerve. Pressure accounts for the absorption of the bone, and the anesthesia of the wrist and hand permits the pressure to continue without pain.

The pressure necessary for the complete concentric absorption of the small bones comes from two sources. The first of these is the local leprous lesions in the soft tissues of the hands and the feet, which produce constant pressure and cause the nicks, grooves, slices, and frayings of Murdock and Hutter. The second source of pressure is the trauma of use. The loss of muscle power, which is produced by the degeneration of the motor fibers in the nerve trunks, results in a muscular inequality in the intrinsic muscles of the feet. The normal arches of the foot are destroyed and deforming contractures result. The pressure caused by function is thereby increased, and the period of use prolonged because of the anesthesia, which has removed the limiting factor of pain. The pressure ulcers which follow are known as the neurotrophic ulcers of leprosy. When these occur, they cause additional pressure of local inflammation.

CONCLUSIONS

Fifteen patients were selected from a group of 120 with leprosy and studied in an effort to explain the phenomenon of complete concentric bone absorption. We believe that all the factors necessary for bone absorption are present, disturbance of circulation, anesthesia, and pressure. These three factors working together, without any other lytic agent or force, are sufficient to account for all the bony changes that occur in leprosy.

The authors wish to express their appreciation to Dr. E. Hurwitz, Superintendent of the Palo Seco Leprosarium.

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Treatment of Retinoblastoma
Radiation Therapy Supplementing Surgical Treatment[1]

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RETINOBLASTOMA is second in frequency of the malignant neoplasms of the eye, malignant melanoma being the most common. The tumor is also designated by pathologists as "glioma of the retina" and "neuro-epithelioma." Since it contains no glia cells, the older designation, "retinal glioma," has fallen into disrepute as an accurate descriptive term. It is still, however, the most commonly used name for this tumor.

Retinoblastoma arises for the most part from the ciliary portion or from the posterior segments of the retina. According to Wintersteiner (20), the origin is often multiple and chiefly from the posterior pole. The tumor grows into the eyeball, stripping the retina from the choroid or covering it with a mass of tissue which encircles the vitreous or penetrates it. It may invade the choroid to form a mass in that structure and may travel within the optic nerve to the base of the brain.

This tumor occurs in approximately 90 per cent of cases before the fourth year. In our small series 50 per cent were bilateral. Most authors report bilateral involvement in 20 to 25 per cent.

The treatment of retinoblastoma must be planned primarily, as in the case of any malignant tumor, to preserve life. This malignant tumor is different from many in that, while it may metastasize, its tendency to do so is not great; thorough local eradication may therefore effect a cure.

A second objective to be attained is preservation of sight. We are faced with the alternative, in treating bilateral retinoblastoma, of recommending removal of both eyes as a life-saving procedure, or of attempting to destroy the tumor, at the same time conserving vision in one eye. This involves removal of one eye and irradiation of the other.

In a few cases it will be the purpose of therapy, whether surgical or by some radiation procedure, to relieve pain and make the last days of the victim as comfortable as possible, recognizing that neither sight nor life can be preserved.

The object to be attained will depend on the degree of involvement and progress of the disease. Of the three objectives, preservation of life must be considered of most importance. We must take the attitude in the treatment of malignant tumors that, generally speaking, no sacrifice is too great if there is a possibility that life can be maintained in a reasonable degree of comfort. In the discussion of the treatment of retinoblastoma found in the literature, the suggestion is made by several authors that, if it is necessary to remove both eyes, the ensuing life of blindness will be too unhappy to contemplate. They imply that the policy of letting nature take its course is more to be desired than bilateral enucleation. While there are cases on record of spontaneous cure of retinoblastoma without treatment (11), the possibility of this miracle is too remote to merit consideration. Anyone who has seen a neglected, untreated case go through the terminal days and weeks of suffering will certainly look with favor on any treatment,

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even though it results in a life of blindness, if it offers a small chance of avoiding such a death. It is doubtful if complete blindness, especially in one who perhaps cannot remember ever having been able to see, is a grave tragedy. It has been our observation that the properly trained blind person is usually a happy one. We maintain that it is not for the physician or parents to withhold from a child treatment that may be life-saving even though blindness results.

A large percentage of unilateral retinoblastomas will be cured by surgical removal of the eyeball with as long a section of the optic nerve as possible. A smaller number of patients with bilateral involvement may be saved by the same procedure. Reese (15) has shown in his study of a series of 119 cases of retinoblastoma a reason for routinely treating the optic nerve with radiation following enucleation. In this series 52 per cent showed malignant tissue invading the optic nerve posterior to the lamina cribrosa, and in 81 per cent of this group it was found that the optic nerve had not been severed distal to the extension of the tumor. "In other words," says Reese, "43 per cent of the 119 cases were doomed to failure before the patient left the operating room." Extension to the nerve occurred as frequently with a small as with a large growth. In the same series 10 per cent were shown to have broken through, resulting in extraocular extension. This occurred late, in the presence of a large growth. It seems logical to assume, in view of this study, that in some cases there will be a greater life expectancy if the orbit and optic nerve are given postoperative irradiation.

There is a feeling that if, on removal of the eyeball, no tumor is found in the nerve the prospect for cure is good. In at least one of our cases (Case 9), following surgical removal of the eyeball and a report of a normal nerve, recurrence developed in the nerve, projecting into the orbit. The rather large number of cases of massive recurrence in the orbit following enucleation also demonstrates the fallacy of depending on surgery alone. We depend on postoperative irradiation in the treatment of carcinoma of the breast to improve our percentage of cured cases. It seems as logical to irradiate retinoblastoma postoperatively even though the pathologist finds no tumor in the nerve removed.

Some authors report a relatively high cure rate by surgical procedure alone. The following results have been recorded:

Hirschberg (6), 75 cases, 5 per cent cured
Wintersteiner (20), 497 cases, 13 per cent cured (two-year cures)
Leber (10), 28 cases, 57 per cent cured
Adam (1), 46 cases, 57 per cent cured
Army Medical Museum (2), 95 cases, 14 per cent cured (five-year cures)

Whether radiation can add to the life expectancy remains to be seen. In our short period of observation we feel that it will.

Bilateral involvement constitutes a much more serious problem than retinoblastoma in a single eye. Our method of interstitial irradiation of the remaining eye is not a satisfactory solution of the problem of maintaining vision and, at the same time, preserving life. The method was instituted without precedent and has been discontinued in favor of a more logical procedure of external irradiation with x-rays as described by Martin and Reese (11 and 12).

Massive recurrent retinoblastoma or retinoblastoma that has metastasized to bones and to regional nodes is treated with no thought of cure. Our mission in a case of this type is to relieve pain and make the patient as comfortable as possible. One has the opportunity of demonstrating in a case of massive recurrence that, even though this tumor is not classified as radiosensitive, it has a degree of sensitivity. We are therefore justified in the assumption that retinoblastoma, wherever found, if not surgically removable, should be given the benefit of irradiation.

HISTORICAL

Reports of treatment of retinoblastoma by radiation were published prior to 1920

by Hilgartner (5), Axenfeld (3), Kusama (9), Janeway (7), and Knapp (8). Several of these cases were not followed for a sufficiently long period of time to justify the value of the procedure. Schoenberg (16), however, reported a case in which, after enucleation of one eye, the other eye was treated with radium. At the end of three and one-fourth years the child was still alive with a cataract. Later the case was reported (17) as a ten-year cure with successful removal of the cataract. In discussing his case Schoenberg suggests the possibility of a spontaneous cure because of the small amount of radiation used. He agrees with Axenfeld (3), who very logically says: "Somewhere midway between the complete resistance to radiation and a tendency to spontaneous cure of the tumor there must be a group of retinogliomas that will respond more or less readily to x-ray and radium treatment."

Verhoeff (19) reported a case followed for three years, in which, with x-ray treatment, the tumor in the second eye was made to regress, with maintenance of good vision.

The first report of interstitial irradiation of the remaining eye is that by Moore, Stallard, and Milner (13). Removable radon implants averaging about 3.5 mc. with 0.5 mm. platinum filtration were used. Five patients were followed for twenty-two months or less. Definite regressive changes were seen in the tumor, but the time interval between the application of the treatment and the report of the cases was not sufficient to permit an opinion as to possible cure or preservation of sight. Stallard (18) later described in detail the surgical approach and technical method of applying a radon seed to the tumor.

Borley (4) reported the unsuccessful treatment of a retinoblastoma in the remaining eye with radium seeds enclosed in a stent of wax, so molded that it would closely fit the scleral curve. This was slipped into position after an incision was made through the conjunctiva and Tenon's capsule and after a tenotomy of the lateral rectus muscle was carried out.

Martin and Reese (11), in 1936, presented for the first time a scientific method of irradiation based on the biological principle developed by Coutard in the treatment of pharyngeal carcinoma. At the time of their report they had treated or were treating 6 cases of bilateral retinoblastoma, none of which had been followed for as long as three years. They were sufficiently satisfied with the regression of the tumor in the remaining eye, however, to advocate strongly the technic of divided doses of x-ray therapy, applied for a long period through multiple small portals.

A subsequent report in 1941 (12) on these and an additional 4 cases showed 8 of the patients living, 5 with vision. Two had had vision for six and seven years, respectively. Martin and Reese also report a series of 6 cases in which tumor was found in the portion of the nerve removed at enucleation. Five patients are living and well following irradiation. Nine patients with recurrent tumor in the orbit are all dead. The fact is emphasized that immediate irradiation of the nerve and orbit of the enucleated eye offers a good chance for cure even though the optic nerve is involved, while if there is recurrence in the orbit before irradiation is started the prognosis is extremely poor or hopeless.

DIAGNOSIS

Usually an accurate diagnosis of retinoblastoma can be made by the ophthalmologist. It is important, of course, that his clinical impression shall be accurate, since this is one tumor that does not lend itself to biopsy with the possibility of subsequent removal following pathological verification of the diagnosis.

A study made by Pfeiffer (14) reveals the fact that 75 per cent of retinoblastomas contain calcification. This appears as a characteristic, mottled, irregular pattern. Roentgen examination should be done in all doubtful cases in an attempt to demonstrate this calcification.

AUTHOR'S METHOD OF IRRADIATION

Our radiation therapy has been used (1) to prevent recurrence following enucleation of an eye because of retinoblastoma and (2) to preserve vision in the remaining, least involved eye when the tumor was bilateral.

In treating the optic nerve stump following enucleation we found 10-mg. monel metal needles ideal in size for insertion. We recognize the advantage of heavily filtered radium in the treatment of many malignant processes. In this situation, however, irradiation is limited to the few millimeters adjacent to the optic nerve stump, and we felt that a caustic dose would be more efficient than a more penetrating ray produced by heavier filtration. We also felt that, if the needles could be left in place for a relatively short period of time, danger of infection would be less than if needles of low radium content and high filtration remained in place for a long period. The needles we use are filtered with monel metal, having a wall thickness of 0.3 mm. The total length is 19 mm. and the radioactive length is 12 mm. The insertion of gold-filtered implants as a prophylactic procedure would have been as logical, possibly, as the procedure adopted by us but, since the implants were not readily available locally, this type of radium therapy was not considered.

Our method in most cases was to implant from four to six monel needles, usually of 10-mg. size, adjacent to the nerve stump. This was done immediately following enucleation. The dose varied between 400 and 1,000 milligram hours. If the tumor had broken through the sclera or if it was a recurrent tumor following enucleation, a radium capsule having a wall thickness of 1 mm. gold was packed into the orbit following removal of the tumor. A dose as high as 1,350 milligram hours has been given. It is possible that in lesions of this type deep x-ray therapy to the orbit would be just as satisfactory in its ultimate result as is radium used as described.

In our earlier cases, when the other eye also contained tumor, we used the same type of radium needles. A ring of four or five 10-mg. needles was implanted between the sclera and Tenon's capsule about the periphery of the orbit, getting as great a concentration of radiation as possible close to the tumor. The needles were left in place for a dose varying from 350 to 610 milligram hours.

We have discontinued treatment of the remaining eye with radium needles because of the damage produced in the normal elements of the eyeball by the caustic dose. X-ray therapy with 200 kv.p. and heavy filtration brings about regression of the tumor with fewer complications. The beam is directed through three small ports cross-firing the eyeball.

COMPLICATIONS

Meningitis is a possible complication following any intraorbital instrumentation or manipulation. Our needles were inserted into the tissue of the posterior orbit under the same sterile precautions and, in fact, as part of the same operative procedure as the enucleation. We have had no case of meningitis. Martin and Reese (12) report one death from meningitis following insertion of radon seeds. In this case they were dealing with a recurrence, with a large mass filling the orbit. The implants were inserted following the removal of the mass. It seems to us that a recurrent tumor will be more likely to become infected than a primary one. We are recommending the use of radium inserted into and adjacent to the optic nerve stump only after removal of a primary growth and not after removal of a recurrence.

Martin and Reese (12) have thoroughly discussed the complications that occur following x-ray therapy. These can be listed as follows: keratinization of the conjunctiva and corneal epithelium; glaucoma; cataract; atrophy of the globe. Any of these complications may occur with our method of radium therapy. Atrophy of the globe is the most common complication when radium is inserted about the periphery of the remaining eyeball. While we are not advocating our

TABLE I: SUMMARY OF DATA ON TWENTY CASES OF RETINOBLASTOMA

Case, Age, Sex	Degree of Involvement	Evidence of Nerve Involvement	Treatment	Living or Dead	Duration of Life Since Treatment	Vision	Primary or Recurrent
1. 13 yr. M.	Single	Yes	X-ray therapy following enucleation of left eye	Living	21½ yr.	Good in uninvolved eye	Primary
2. 4 yr. M.	Single	No	Single small dose of x-ray therapy following enucleation	Dead 2 months later			Primary
3. 5 yr. M.	Single	No	Enucleation of left eye; no radiation	Living	17⅓ yr.	Good in uninvolved eye	Primary
4. 15 mo. F.	Both	No	Enucleation of left eye. Radium pack and x-ray to right eye	Living	16⅔ yr.	3/60 in right eye	Primary
5. 2 yr. M.	Single	No	Surgical removal of left eye	Not followed			Primary
6. 2 yr. F.	Single	Yes	Surgical removal; no radiation	Dead 3 months later			Primary
7. 2 yr. M.	Both	Unknown	None	Not followed			Primary
8. 11 mo. F.	Both	No	Enucleation; first left, later right. Interstitial radium	Dead 3 years later			Primary
9. 2 yr. F.	Single	None seen by pathologist but recurrence later	Enucleation and interstitial radium about nerve head	Living	9 yr.	Good in uninvolved eye	Primary—later recurrent
10. 2 yr. F.	Single	No	Removal of recurrent mass and interstitial radium	Dead 6 months later			Recurrent
11. 14 mo. M.	Both	Unknown	Refused by parents	Not followed			Primary
12. 4 yr. F.	Single	Yes	Removal of recurrent mass and interstitial radium	Dead 14 months later			Recurrent
13. 15 mo. M.	Both	Yes	Enucleation of left eye. Radium interstitially to stump on left and to right eye	Living	7½ yr.	Light perception	Primary
14. 18 mo. M.	Both	Yes	Interstitial radium and bilateral enucleation	Dead a year and a half later			Primary
15. 9 mo. F.	Both	No	Enucleation of left eye. Interstitial radium. Later enucleation of right eye	Living	7 yr.	None. Both eyes removed	Primary
16. 6 wk. M.	Single	No	Enucleation; x-ray therapy	Living	4 yr.	Good in uninvolved eye	Primary
17. 3 mo. M.	Both	No	Enucleation of left eye. X-ray therapy to right eye	Dead 3½ years later			Primary
18. 9 mo. M.	Both	No	Enucleation of left eye. X-ray therapy to right eye	Dead 2 years later of pneumonia			Primary
19. 3½ yr. M.	Both	No	Enucleation of right eye. X-ray therapy to left eye	Living	2½ yr.	20/50 in left eye	Primary
20. 4 yr. M.	Single	Yes	Removal of recurrent tumor and x-ray therapy	Dead 5 months later			Recurrent

method as a means of conserving sight in the remaining eye, we point to the one case in which light perception has been present for a period of seven years following this method of treatment, without atrophy of the eyeball (Case 13).

Our method of treating the remaining eyeball was used before the technic and results of x-ray therapy were described by Martin and Reese. We have since adopted a modification of their procedure and are using it in preference to radium insertion. In the treatment of the optic nerve stump, however, we advocate implantation of radium needles or radon seeds about the nerve head as a more satisfactory method than roentgen therapy. The insertion is done while the child is quiet under the influence of an anesthetic. Movement of the patient during x-ray therapy may render satisfactory accurate localization of the ray difficult. The treatment with radium may be accomplished in a few hours as compared to a long time interval if x-ray therapy is used. A caustic dose may be applied to the few millimeters of the nerve that may be involved. If involvement has spread farther than a few millimeters, it is doubtful if any type of radiation will be of great value.

RESULTS

During the twenty-one-year interval between April 1921 and August 1942 our records show that 20 cases of retinoblastoma have been seen in The University of Kansas Hospitals. Data on these cases are tabulated as follows:

- TOTAL CASES 20
  - Primary 17
  - Recurrent (following removal elsewhere) 3
- BILATERAL RETINOBLASTOMA 10
  - Dead 4
  - Living 4
    - All treated with surgery and radiation. Life duration since treatment:
    - Case 4: 16 1/2 years
    - Case 13: 7 years (in this case tumor was seen in the nerve of the enucleated eye)
    - Case 15: 7 years
    - Case 19: 2 1/2 years
  - Not followed (considered hopeless, not treated) 2
- UNILATERAL RETINOBLASTOMA 10
  - Treated by surgery alone 3
    - Dead 1
    - Living 1
      - Case 3: 17 years
    - Not followed 1
  - Treated by surgery and radiation 7
    - Dead 4
      - Includes 3 recurrences after operation elsewhere
    - Living 3
      - In 2 of these tumor was demonstrated in the optic nerve at operation
      - Case 1: 21 years
      - Case 9: 9 years
      - In one no tumor was seen in the optic nerve at operation
      - Case 16: 4 years
- RECURRENT RETINOBLASTOMA 4
  - Dead 3
  - Living 1
    - Case 9: This case was seen by us as a primary tumor. The eye was enucleated and radium was implanted about the optic nerve stump. Recurrence followed and was again treated with radium implants about the stump of the optic nerve. This is now a 9-year cure.
- PATIENTS WITH BILATERAL RETINOBLASTOMA WITH SIGHT IN ONE EYE 3
  - Treated with x-ray and radium surface application 1
    - Case 4: 16 1/2 years
  - Treated with x-ray only 1
    - Case 19: 2 1/2 years
  - Treated with interstitial radium 1
    - Case 13: 7 years

CASE HISTORIES

CASE 1 (Hospital No. 10622): G. K., white male, age 13, was seen in Doctor Curran's office Oct. 22, 1920, complaining of inability to see with the left eye. There had been pain in the eye all summer. This eye felt harder than the right, but the change was not marked. A cataract was at first suspected; later a definite diagnosis of glioma was made, and in April 1921 the eye was enucleated. The pathological report was glioma of the retina with extension to the optic nerve.

Following operation, x-ray therapy was given to the orbit, in the office of Doctors McDermott and Virden of Kansas City, Mo. Between April 30, 1921, and Nov. 12, 1921, the patient received seven treatments anterior to and seven lateral to the orbit. Factors were recorded as follows for each treatment: 5 ma., 8-in. spark gap, 5 mm. Al filter, distance 12 in., time 8 minutes.

This boy, even though there was tumor in the optic nerve, is living twenty-one years following the diagnosis of retinoblastoma. He was seen in May 1942, by Doctor Curran.

CASE 2 (Hospital No. 11487): J. F. R., white male, age 4, was admitted Nov. 18, 1921. On Nov. 10 his mother noticed a peculiar light reflex in the left eye and discovered that the patient could not see with this eye. The results of physical examination were reported as follows: "The child is blind in the left eye. The vitreous chamber is almost filled with tumor. Small round floating opacities are seen in the vitreous. The largest of these is 1 mm. in diameter. The right eye appears normal."

On Nov. 18, the left eye was enucleated. The pathological report was glioma of retina. A section through the optic nerve showed no tumor cells.

From Nov. 20 to Nov. 26, 1921, x-ray therapy was administered to the anterior left orbit, with the following factors: 4 ma., 8-in. spark gap, 4 mm. Al filter, distance 12 in., time 8 minutes.

The child died at home on Jan. 4, 1922. There was no recurrence in the orbit. Two weeks prior to death, when the patient was last seen, the liver was almost twice normal size. It was nodular in a manner characteristic of tumor metastasis.

CASE 3 (Hospital No. 16427): E. A., white male, age 5, was admitted June 21, 1925. Eight months earlier the mother noticed a white object inside of the left eyeball. The patient stated that he had some pain in the eye. A whitish reflex was seen on examination of the left eyeball. The right eye appeared normal. The clinical diagnosis was retinoblastoma and the left eye was enucleated, June 22, 1925. The pathological diagnosis was glioma of the retina.

The patient came in for observation on Aug. 27, 1942. He is attending school and appears to be in perfect health.

CASE 4 (Hospital No. 18208): A. K., white female, age 15 months, was admitted Jan. 7, 1926. Her mother had noticed a spot on the left pupil when the baby was six weeks old. The spot spread gradually over the eye. A clinical diagnosis of retinoblastoma was made by Doctor Curran.

On March 12, 1926, the child was admitted to the hospital for enucleation of the left eye. A diagnosis of retinoblastoma in the right eye, also, was made at this time.

The larger part of the tumor in the left eye was in the posterior portion of the eyeball. A considerable amount of gritty, sand-like material was found here. The histological report was glioma of the retina.

The child was given one x-ray treatment (May 25, 1926) and several radium treatments in the office of Doctors McDermott and Virden of Kansas City, Mo. (Unfortunately the record of treatment has been lost, but Doctor Virden recalls that a small radium pack at a distance of 1/2 in. was applied several times.)

Nov. 26, 1926: The mother thinks that the child sees better. Examination of the fundus of the right eye shows less tumor.

Sept. 1, 1931: The tumor has cleared up above the disk. White areas are still seen. Remains of old hemorrhage are seen adjacent to the macula.

Aug. 2, 1933: Vision in the right eye is 15/200 without glasses.

Sept. 17, 1942: A letter from the father says the child is in a school for the blind. Her vision without glasses is 3/60.

CASE 5 (Hospital No. 21398): E. L. S., white male, age 2, was admitted Jan. 27, 1927. Four months earlier it was noticed that the child's vision in the left eye was poor and that the pupil of his left eye had a white reflex. At the time of admission there was no vision in the left eye, and the pupil had a grayish, glassy appearance. The eye was enucleated Jan. 28, 1927, and the pathological report was glioma of the retina. We were unable to follow this case.

CASE 6 (Hospital No. 28067): B. S., white female, age 2, was admitted June 28, 1929. Two weeks earlier the child was seen to have a swollen eyeball. Examination showed the right eye protruding from the socket and the lower conjunctiva everted, edematous, and inflamed. The child had pain.

The right eye was enucleated July 19, 1929. Tumor could be felt entering the cranial cavity through the optic foramen, on examination following enucleation. The pathologic diagnosis was retinoblastoma showing invasion of the optic nerve and extension into the tissue outside the eyeball.

The child died at home, Oct. 1, 1929.

CASE 7 (Hospital No. 39663): R. B., white male, age 2, was admitted May 9, 1932, and dismissed the same day. Gradually growing white masses had been noticed in both eyes for one year. The child had been blind for this period. The right eyeball was enlarged and nodular, filled with a yellow mass. There was a yellow mass, also, filling the posterior half of the left eye, with blood vessels extending over the mass. Hard cervical nodes were palpated on both sides. Because of the hopelessness of the condition, no treatment was advised. The case could not be followed.

CASE 8 (Hospital No. 44249): G. R., white female, age 11 months, was admitted April 28, 1933. As soon as the child was born the parents noticed something peculiar about the left eye. At eight months of age a doctor was consulted, and a diagnosis of congenital cataract was made. Two months prior to admission photophobia and a slight discharge developed in this eye.

The left eye was enucleated May 16, 1933. The pathological report was retinoglioma, showing necrosis and calcification

From June 26 to June 28, 1933, a total dose of 1,000 r was delivered into the left orbit. The factors were as follows: 120 peak kv., 5 ma., 3 mm. Al filtration, distance 13 in.

On Dec. 27, 1934, the child was readmitted, with tumor in the right eye. Six 10-mg. monel metal needles were inserted about the periphery of the right eye, for a total dose of 360 mg. hours.

The patient was again readmitted April 10, 1935. Examination by Doctor Curran at that time showed a great deal of disintegration of the tumor. The subsequent history was as follows:

May 6, 1935: Following insertion of radium the eyelids became edematous. There has been photophobia. On examination the right eye shows a muddy anterior chamber and there are a few posterior adhesions. There is deep pericorneal injection.

June 17, 1935: The patient is listless; appetite is poor; she will not play.

July 7, 1935: The patient is feeling much better. She plays some and does not sleep so much. Her appetite is still poor.

Oct. 9, 1935: Examination shows the left periorbital tissue considerably depressed. There is a slight mucopurulent discharge from the right eye. Six 10-mg. monel metal needles were inserted about the periphery of the right eyeball, for a total dose of 250 mg. hours.

Jan. 6, 1936: During the last six weeks the right eyeball has been getting larger. Discharge is present and there is considerable pain. Examination shows an enlarged right eyeball; it is tender; there is a purulent discharge.

Jan. 15, 1936: Right eye removed. Pathologic diagnosis: Retinoblastoma with infiltration into the optic nerve, right eye.

Jan. 22, 1936: Five 10-mg. radium needles were inserted for eight hours about the nerve head on the right. A total dose of 400 mg. hours was given.

Feb. 11, 1936: Condition is critical.

March 17, 1936: Patient died at home.

CASE 9 (Hospital No. 46174): V. A. W., white female, age 2, was admitted Sept. 3, 1933. Ten months previously the parents noticed a gray spot in the right eye when light came in from the side. This had gradually enlarged. Two months before admission they noticed that the sight was gone from this eye. Examination showed a cat's eye reflex in the right eye and gray floating opaque material, clumped and nodular, in the vitreous humor.

The right eye was enucleated on Sept. 3, 1933. Five 5-mg. radium needles were imbedded about the optic nerve, for a total dose of 250 mg. hours. The pathological report was retinoblastoma of the right eye. "A section was taken through the optic nerve. No cells that were recognizable as tumor cells could be seen. However, in the loose tissue around the outside of the sclerotic coat, there are some rounded oval cells, of an atypical nature, which may be neoplastic in origin."

The child was readmitted for observation Oct. 9, 1933. The eye had healed well but there still remained a small opening in the region of the optic foramen.

Jan. 29, 1934: Patient admitted for observation. There is recurrence of tumor in the nerve head.

Five 10-mg. radium needles were inserted about the optic nerve head and left in place for fifteen hours. Total dose, 750 mg. hours.

Feb. 5, 1934: A letter from the mother of the patient states: "For the first four days Virginia took practically no nourishment. Seemed to be more or less in a stupor. She does not appear to be in a great deal of pain. She wants to be held or rocked most of the time and rests this way easily. It has been necessary to give her codein tablets at night in order for her to get any sleep."

Nov. 7, 1934: The patient was seen. She looks well; there is no recurrence.

Sept. 1, 1935: Letter from mother: "Virginia Ann seems to be in the best of health. She is quite active and plays with other children freely."

The patient was seen at intervals during 1936, 1937, and 1938. On the last examination, March 1, 1938, there was no evidence of recurrence.

Aug. 10, 1942: A letter from the mother informs us that the patient is in perfect health.

CASE 10 (Hospital No. 51065): B. J. W., white female, age 2, was admitted Aug. 22, 1934. Four months earlier the mother noticed that the left eye showed a cat's eye reflex. The eye began to enlarge. Three months prior to admission the eye was removed in another hospital. Five days before admission the tumor was seen to be growing, causing the lid to bulge.

The left lids were almost closed, yet bulged slightly from an apparent growth behind. This growth was cellular in appearance and grayish-white in color; blood vessels were seen running over the surface. On Aug. 24, by sharp dissection and cautery the tumor was removed. The pathological report was recurrent retinoglioma.

Following removal of the tumor, five 10-mg. monel needles were inserted into the tissue adjacent to the optic nerve, a total dose of 750 mg. hours being given. Twenty-five milligrams, in a capsule 1.5 cm. long with 1-mm. gold wall, was packed into the orbit. A total dose of 500 mg. hours was given.

Examination on Sept. 24, 1934, showed the patient to be very fretful, but otherwise normal. For a period of approximately one week following irradiation she was bright and felt well. Then she grew restless, had temperature as high as 100°, became drowsy, and complained of pain in the back of her head. She had no convulsions. It was felt that her condition was probably due to the radiation rather than tumor extension. Temperature ranged from normal to 101° during eight days in the hospital.

The patient was readmitted Jan. 11, 1935, and following this recuperated rapidly, was very active and felt good. Six weeks previously she had a cold and complained of pain in the muscles. There had been some difficulty in locomotion. Examination showed the liver down about two fingers breadth. The right eye was normal. There were some nodules in the lower portion of the left orbital cavity which might possibly be due to recurrence.

Death occurred at home, Feb. 23, 1935. Convulsions occurred prior to death and the child suffered considerably.

CASE 11 (Hospital No. 53531): K. Y., white male, age 14 months, was admitted Feb. 2, 1935. About two and one-half months earlier it was noticed that the left eyeball was more prominent than the right. This became gradually more pronounced, and two weeks before admission a physician informed the family that the child had a tumor in the left eye.

Physical examination showed a large glioma in the left eye. The retinal vessels were fairly normal. There was a glioma, also, in the right eye, pushing the posterior portion of the retina forward.

Surgical removal of the left eye and radiation therapy of the right eye were recommended, but refused by the parents. The child was dismissed on Feb. 2, 1935, without treatment. There is no follow-up record on this case.

CASE 12 (Hospital No. 53769): M. C. H., white female, age 4, was admitted Feb. 20, 1935. A small tumor had been discovered in the right eye seventeen months previously. This had increased gradually in size, and the eye was removed, Nov. 5, 1934, at another hospital. Recently the child had not felt well and the remaining tissue in the right orbit had increased in size. The pathological diagnosis at the other hospital was glioma of the retina with extension into the optic nerve.

Examination showed bulging of the lids of the right eye and replacement of the eyeball by a tumor.

The tumor in the right orbit was removed Feb. 22, 1935, with the endotherm. The pathological report was glioma of the orbit. Five 10-mg. monel needles were inserted adjacent to the optic foramen, for a dose of 800 mg. hours. Into the orbit a 25-mg. capsule was packed (filtration 1 mm. gold) at a distance of 1 cm. from the posterior wall, for a total dose of 1,350 mg. hours.

About Aug. 5, 1935, it was noticed that vision in the left eye was gone. As no evidence of tumor could be seen in the orbit, it was assumed that the loss of vision was due to extension to the optic nerve on this side.

The patient was readmitted Nov. 5, 1935. Three weeks earlier she had begun to vomit, had lost her appetite, and had a moderate cough. Examination showed moderate drainage from the right orbit. No evidence of tumor was seen in the left orbit. The patient was blind in that eye. X-ray examination showed spreading of the sutures, due to increased intracranial pressure.

The patient remained in the hospital until April 20, 1936. During most of this period she was unconscious. Temperature ranged as high as 105°. Death occurred in the hospital. No source of infection was seen to account for the child's condition. Unfortunately an autopsy could not be obtained. It is our opinion that meningeal irritation from tumor could account for the symptoms described, including the high temperature.

CASE 13 (Hospital No. 54792): F. C., white male, age 15 months, was admitted April 23, 1935. Three months before this the mother had noticed a red reflection from the left eye at night when light was directed into the eye. Two weeks later the conjunctiva became inflamed. Physical examination revealed retinoblastoma in each eye. The left showed the greatest involvement.

On April 27, 1935, enucleation of the left eye was done, followed by radium insertion. The pathological report was: "neuroglioma of the retina showing some secondary inflammatory reaction. A portion of the optic nerve can be seen in which rather extensive tumor infiltration can be recognized." Six 10-mg. monel metal needles were inserted about the periphery of the right eyeball; dose 350 mg. hours. Nine 5-mg. monel metal needles were inserted adjacent to the optic nerve of the enucleated left eye; dose 810 mg. hours.

June 10, 1935: Examination shows that the tumor in the right eye has regressed

July 9, 1935: There is only slight discharge from the left optic foramen; a bandage is not necessary. The lids are swollen. The child sleeps much and plays but little. He has no fever.

Dec. 3, 1935: The health is normal. The child is gaining weight, sleeps well, and eats well.

Dec. 24, 1935: The patient was seen at this time. He has vision in the right eye.

Feb. 26, 1936: The mother feels that the sight in the right eye is normal.

March 20, 1936: The sight appears normal. Child is gaining weight.

June 27, 1936, and Dec. 16, 1936: The mother considers the sight in the right eye normal.

Sept. 1, 1937: The mother reports by letter that the vision is failing.

Dec. 2, 1937: The general health is good but vision is becoming progressively less.

Dec. 11, 1937: An ophthalmoscopic examination was attempted by Doctor Trueheart of Sterling, Kans. He was unable to see the fundus, due to a cloudy lens.

Nov. 14, 1938: The general health is good. The patient has been seen by Doctor Curran, who says he has a cataract.

Oct. 29, 1941: Removal of right cataract done by Doctor Curran.

June 12, 1942: The vision has not been much improved by the operation. The patient can see trees and other large objects.

Oct. 1, 1942: The child is in the Kansas School for the Blind. He can detect light. No further surgical treatment is recommended at this time.

CASE 14 (Hospital No. 56913): R. E. F., white male, age 18 months, was admitted Sept. 1, 1935. At four months of age it was noticed that the right pupil did not appear dark. Vision failed until total blindness occurred. Three weeks prior to admission the same change was noted in the left eye. Examination showed no response to light flashed in the right eye. There was light perception on the left. The right eye was larger than the left eye.

The right eye was removed on Sept. 6. The pathological report was: "retinoglioma showing extensive secondary inflammatory reaction. Tumor tissue does not directly invade the substance of the optic nerve but it is immediately around it." Six 10-mg. and one 5-mg. monel needles were inserted about the periphery of the left eyeball for a total dose of 390 mg. hours. Six 5-mg. needles were inserted into tissue adjacent to the nerve stump on the right, for a total dose of 710 mg. hours.

On Dec. 15, 1935, the child was readmitted and the left eye was enucleated because of ulceration and tumor formation. Under general anesthesia it was found that the cornea had ruptured and the iris had prolapsed. Pathological examination of this eye did not reveal evidence of tumor, which had been suspected clinically. Following operation three 10-mg. needles were inserted into tissue adjacent to the nerve stump of the right eyeball, for 150 mg. hours. Five 10-mg. needles were inserted into tissue adjacent to the nerve stump of the left eyeball for 250 mg. hours.

Nov. 9, 1936: The patient was seen by Earl H. Gray, M.D., Woodland, Calif., who reports: "The little lad is apparently in good health but has developed a mass in the left temporal area that could be metastatic."

March 22, 1937: Letter from Doctor Gray: "Richard F—— died on about March 7, 1937. He had extensive metastasis to the right supraclavicular chain and clinically appeared to have extensive intracranial metastasis." Examination of the masses in the neck, postmortem, by James B. McNaught, M.D., showed "retinoblastoma, metastatic."

CASE 15 (Hospital No. 57237): J. M. H., white female, age 9 months, was admitted Sept. 22, 1935. Her mother had first noticed that the left eye had a brownish color about two months earlier. Under a general anesthetic both eyes were found to contain tumor. The left eye was enucleated and radium was inserted about the stump of the nerve: three 10-mg. needles for a dose of 435 mg. hours. X-ray examination of the left eye, before and after enucleation, showed calcification in the posterior chamber. The pathological report was "glioma of the eye showing secondary calcification."

Oct. 3, 1935: The child was readmitted. "There is no vision in the right eye. There is profuse drainage from the left orbit." Six 10-mg. monel metal needles were inserted about the periphery of the right orbit, for a total dose of 210 mg. hours.

Oct. 10, 1935: Readmission. Doctor Curran reported as follows: "There has been regression of the tumor in the right eye. A gliomatous mass is still present in the upper nasal quadrant and in the region of the macula."

Nov. 6, 1935: Radium needles were again inserted about the periphery of the right eye—five 10-mg. monel needles, for a total dose of 150 mg. hours.

Dec. 11, 1935: Readmission. Examination showed the eye to be quiet, with regression of tumor. No therapy.

Feb. 4, 1936: Readmission. Regression of tumor was seen.

Feb. 7, 1936: Six 10-mg. radium needles were inserted about the periphery of the right eyeball, for a total dose of 210 mg. hours.

June 8, 1936: A letter from the parents says: "She has only partially opened her eye, which is covered with a thick film. This seems to be getting thicker. Until recently she could see a little, now she apparently has no vision. The eye does not appear to be swollen or irritable."

June 21, 1936: Readmission. Since leaving the hospital five months ago, the child has gained weight and has been apparently quite healthy. There is very little orbital drainage on the left side. The right eyeball is shrunken. It was examined under anesthesia and it was decided that the eye should be removed.

July 12, 1936: Under general anesthesia the remains of the right eye were removed. The pathological report was "chronic inflammatory and scar tissue containing some clumps of neoplastic cells in the blood vessels." Three 10-mg. monel needles were inserted (July 15) about the nerve head on the right for a total dose of 450 mg. hours.

Feb. 12, 1937: A local physician reported only slight drainage from the right eye.

May 21, 1937: The patient is in excellent health. There is no drainage from either eye.

May 6, 1942: A letter from the parents says: "The patient is still in the best of health. She attends school and is getting excellent grades."

Sept. 5, 1942: The patient was seen and examined. She is in excellent health. The remaining tissues of each orbit appear healthy. There is no damage to the bony structure of either orbit.

CASE 16 (Hospital No 74755): G. P., white male, age 6 weeks, was admitted Oct. 17, 1938. A cat's eye reflex was noticed by the parents one week prior to admission, in the left eye. The eye was enucleated, Oct. 18. The pathological report was "retinoblastoma. Definite evidence of infiltration of the optic nerve was not seen."

From Oct. 25 to Oct. 31, 1938, x-ray therapy was given lateral to the left orbit, 1176 r. The factors were as follows: 20 ma., 200 kv.p., 50 cm. distance, Thoraeus A filter, 6 × 6-cm. portal.

April 24, 1942: Letter from mother: "Gary is in excellent physical condition. He sees extremely well with his right eye and wears an artificial eye on the left."

CASE 17 (Hospital No. 74971): J. W., colored male, age 3 months, was admitted Nov. 1, 1938. One week before admission it was noticed that the color of the left eye had changed from a brown to a blue-gray. On examination of the left eye the cornea was found to be covered with a bluish haze. The eye was distinctly harder to palpation than was the

right. In the right eye there was a cat's eye reflex. Vision was not entirely gone. The diagnosis was bilateral advanced retinoblastoma.

On Nov. 2, the left eye was enucleated. Enucleation of the right eye was recommended, but was refused by the parents. Between Nov. 5 and Dec. 1 x-ray therapy was given to the lateral right orbit, with the following factors: ma. 20, kv.p. 200, distance 50 cm., Thoraeus A filter, portal 10 × 10 cm. A total dose of 1,768 r was given.

Dec. 6, 1938: Examination under anesthesia shows no change in the appearance of the tumor in the right eye, following a series of x-ray treatments.

Oct. 14, 1941: The child was admitted on this date, approximately three years following the first observation. The parents stated that vision remained in the right eye until January 1941. Examination showed no recurrence of tumor in the left eye. The right eyeball protruded. A mass 3 × 4 cm. was palpable over the right malar bone.

The patient complained of pain in his lower extremities, and x-ray examination showed extensive metastases in the lower half of each femur and in the neck of the right femur. Metastasis was also seen in the left humerus close to the upper epiphysis.

Between Oct. 31 and Nov. 15, 1941, x-ray therapy with factors as previously described was given. A total of 1,890 r was delivered to the right lateral oribt, and the same dose to the anterior aspect of each femur.

Enucleation of the right eye was done. A pathological report of retinoblastoma showing extensive necrosis and infiltration into the extraocular muscle and orbital tissue was made.

The patient was dismissed on Nov. 16, showing some relief of pain and moderate reduction of the tumor. He died at home on Jan. 11, 1942.

CASE 18 (Hospital No. 80969): M. B., white male, age 9 months, was admitted Nov. 10, 1939. A large intraocular tumor was discovered in the left eye five weeks prior to admission. A smaller tumor was seen in the right eye. The left eye had been enucleated elsewhere. The pathological report, from the Army Medical Museum, was "retinoblastoma." In the right eye was a flat, slightly elevated, whitish mass arising from the temporal aspect of the retina.

It was deemed advisable to administer x-ray therapy to both orbits. From Nov. 16 to Dec. 6, 1939, a daily treatment was given, alternating between the two orbits. The factors used were as follows: 20 ma., 200 kv.p., 50 cm. distance, Thoraeus A filter, 10 × 10-cm. portal, 166 r (measured in air) daily dose, half-value layer 1.675 mm. Cu. A total dose of 1,328 r was administered to each lateral orbital area.

On Feb. 19, 1940, examination revealed the following findings: "Under anesthesia definite regression is seen. Instead of the one large mass there are three smaller white areas that seem rather definitely defined."

Examination by Dr. Kevin Curran, March 28, 1940, was reported as follows: "Only three tiny yellowish-white scars mark the place where there were retinoblastoma growths, inferior to the optic nerve."

From March 2 to March 20, 1940, another series of x-ray treatments, similar to that previously described, was given.

From Oct. 25 to Nov. 4, 1940, a total dose of 1,224 roentgens was given to the right lateral orbit. Factors used were as previously described.

June 18, 1941: The mother states that the child's sight has improved considerably since the last dismissal. Examination of the right eye by Doctor Curran is reported as follows: "In the lower temporal region below the macula are seen several pinhead-sized yellowish masses. These appear to be scarred and inactive. There are some spots of patchy choroiditis above the small granules. We believe this eye to be cured at the present time."

The child died of bronchopneumonia in December 1941. The vision was good at the time of death.

CASE 19 (Hospital No. 83542): B. D., white male, age 3 1/2, was admitted April 18,1940. About one month prior to admission the patient began to hold things close to his eyes in order to see them. Examination by a local doctor revealed bilateral tumor.

Examination of the eyes under anesthesia showed "a large retinoblastoma inferotemporal to the right optic nerve" and on the left "a flat retinoblastoma inferotemporal to the optic nerve and apparently including the nerve."

From April 23 to May 11, 1940, a dose of 1,117 r was administered to each lateral orbit. Factors were as follows: kv.p. 200, distance 50 cm., Thoraeus A filter, half-value layer 1.675 mm. Cu, portal 10 X 10 cm. One hundred seventeen roentgens were administered at each treatment. The treatment was alternated between the orbits.

Jan. 27, 1941: Letter from mother: "Bobby Lee sees a great deal better than when he was in the hospital."

May 27, 1941: Readmission. Patient has no vision in the right eye but can distinguish and count fingers with the left eye at four feet.

June 2, 1941: The right eye was enucleated. Pathological report: "Retinoblastoma or neuroepithelioma of the eye."

May 29–June 18, 1941: A total dose of 1,260 r was given to the left lateral orbit; the same amount was given to the right lateral orbit. Factors were the same as in the last series of treatments except for the fact that the portal was reduced to 6 × 6 cm.

Jan. 14, 1942: Readmission. Vision is improved in the left eye to the point that the patient can see writing on paper.

Jan. 17–Feb. 4, 1942: A dose of 1,120 r was given to the left lateral orbit and 480 r to the right lateral orbit.

June 15, 1942: Readmission. The vision on the

Fig. 1. Case 20: Recurrent retinal glioma protruding from the left orbit.

Fig. 2. Case 20: Regression of retinal glioma following x-ray therapy.

left has improved. The patient counts fingers readily and can recognize objects at any distance. Examination was done by Doctor Curran. He reported as follows: "Lesion in the left fundus consists of flat circumscribed white patches."

June 15–July 3, 1942: X-ray therapy was given to the left orbit following the technic of Martin and Reese with modifications; 1,980 r were given to the lateral left orbit, medial left orbit, and inferior left orbit. Factors were as follows: 200 kv.p., distance 44 cm., filter 1 mm. Cu plus 1 mm. Al. Each individual dose was 420 r. Treatment was given daily, alternating between the three areas. The portal was circular, 3 cm. in diameter.

July 1, 1942: Examination (by Dr. Desmond Curran) on dismissal shows a vision in the left eye of 20/50. The media is clear; no actual lesions are noted.

CASE 20 (Hospital No. 94475): D. C., white male, age 4, was admitted Nov. 17, 1941. The parents were told in January 1940 that the child had a tumor in the left eye. On Feb. 22, 1940, the eye was removed in another hospital. In the summer of 1941 recurrence was observed. The patient was given four x-ray treatments before admission to our hospital.

Examination showed a hard mass protruding from the left orbit. It was the size of a large orange and ulcerated (Fig. 1).

X-ray therapy was administered to the left orbit as follows: lateral left orbital mass, 1,470 r; medial left orbital mass, 1,470 r; superior left orbital mass, 985 r; inferior left orbital mass, 985 r. Factors were as follows: kv.p. 200, distance 50 cm., Thoraeus filter, port 6 × 6 cm., half-value layer 1.675 mm. Cu. The daily dose was 210 r, the various areas being treated alternately. The child was dismissed Dec. 28, 1941, with considerable regression of the mass (Fig. 2).

Feb. 4, 1942: Readmission. There has been progressive regression of the tumor, though it still holds the eyelids apart. X-ray therapy was resumed on Feb. 13.

It was observed that the child could not see out of the right eye. Examination by Doctor Curran revealed a normal fundus. It was his opinion that the tumor had extended to the chiasma. From Feb. 5 to March 27 x-ray therapy was administered as follows: right anterior skull, 1,292 r; left lateral orbit, 630 r; right lateral skull, 2,380 r directed to the optic chiasma; left lateral skull, 2,380 r. Factors used were as previously described.

On March 25 a septic temperature developed, which persisted until death on April 27. During the last two weeks of life the child was unconscious and took but little fluid.

A summary of the autopsy findings is as follows: "There is retinoblastoma in the posterior left orbit

and rather widespread invasion of the meninges due to retinoblastoma. The brain stem and cerebellum are invaded by malignant tissue. Other significant findings are degenerative in type." No evidence of regional metastasis was observed.

SUMMARY

Of our 20 cases, half of which were bilateral, 15 received radiation therapy supplementary to surgery. Seven of the 15 patients are living. One treated by enucleation alone is living. Three of those who had evidence of tumor in each eye are living with vision in the remaining eye, the other eye having been enucleated. One of these (Case 19) who was treated with x-rays and who has been followed for a period of over two and a half years has 20/50 vision in the remaining eye. One patient (Case 13) was treated with radium needles imbedded about the periphery of the remaining eye. He has been followed for seven years. A cataract has developed which is being treated. At present he can distinguish trees and other large objects. This child, incidentally, had extensive infiltration into the optic nerve of the enucleated eye. The third patient (Case 4), who received one x-ray treatment and later was treated by small radium packs, is alive sixteen years and a half following treatment, with 3/60 vision. One child (Case 18) treated with x-rays showed almost complete regression of the tumor in the remaining eye. Unfortunately he died of bronchopneumonia after having been followed for over two years. One patient (Case 9) who had a recurrence in the stump of the nerve five months after enucleation is now a nine-year cure. He was treated with interstitial radiation of the optic nerve head.

CONCLUSION

Radiation therapy of retinoblastoma as a supplement to surgical removal is advocated. Routine implantation of radium adjacent to the optic nerve stump at the time of surgical removal of the eyeball, regardless of the pathological report, is considered a logical procedure.

Some cases of bilateral retinoblastoma may be cured, with a degree of preservation of vision, by radiation therapy of the remaining eye. Our experience has been largely with radium therapy. We feel that the treatment of the remaining eye with x-ray therapy, as advocated, is more satisfactory than the use of interstitial radiation as used in some of our earlier cases.

It seems possible, in view of the demonstrable sensitivity of retinoblastoma to large doses of radiation, that an early tumor may be treated and cured by radiation alone. Conservation of life and vision in both eyes is the perfect result to be anticipated. If such a case has been reported, we are not aware of it, but if an early diagnosis can be made, it seems a possibility of the future.

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DISCUSSION

Lewis G. Allen, M.D. (Kansas City, Kans.): The first tragic feature of this disease, of course, is the disease itself. The second is the fact that the patient is a child. Finally, subsequent loss of vision may almost universally be expected.

Doctor Tice's series of cases is unusual in that 50 per cent showed bilateral involvement. I agree with Doctor Tice that the adequate treatment of retinoblastoma should be pursued even at the cost of the sight in the affected eye. While he has pointed out that spontaneous cures may occasionally occur, their incidence is too infrequent to modify our judgment completely.

The character of the extension of retinoblastoma is singular in that the tendency of the tumor is to extend along the optic nerve. This property renders the plan of treatment a little different than that presented in most tumors. Because in a large number of cases there is invasion of the optic nerve posterior to the lamina cribrosa, the treatment of the nerve stump seems essential and for this reason dependence on enucleation alone would seem unreasonable.

The work of Martin and Reese introduces the thought that surgery, either alone or in combination with irradiation, may be challenged.

It would appear that the employment of radium needles of low filtration as used by Doctor Tice is rational in that it is desirable to deliver a relatively intense dose in a comparatively short time and at a short distance. Therefore, the choice of low filtration needles, with their caustic effect, has an advantage.

Doctor Tice has reported no case in which excess irradiation of the orbit was obtained, there being no instance of adjacent bone necrosis or of meningitis.

The sequelae to either radium or roentgen therapy—namely, keratinization of the conjunctiva and cornea, glaucoma, cataract, and atrophy of the globe—are the same sequelae we are accustomed to seeing in extensive malignant lesions of the face where heavy irradiation is employed.

The results in this series, particularly in cases showing bilateral involvement, are impressive. Of 10 patients there were 4 living, 4 dead, and 2 not followed. Of the 10 patients with unilateral disease, 4 are living, 5 dead, and 1 not followed. This gives an approximately identical cure rate in that 40 per cent of each series are still alive. While this percentage is not impressively high, if one considers the seriousness of the lesion when untreated the results are commendable.

Ira I. Kaplan, M.D. (New York): I would like to give Doctor Tice a little idea of the treatment we have been giving one of Doctor Schoenberg's patients, a young child with one eye enucleated and beginning involvement of the remaining eye. We irradiated the remaining eye intensively, applying castor oil under the lid before irradiation and permitting it to remain during treatment. This limited the rapidity with which post-irradiation changes occurred; that is, cataract took much longer to develop. In irradiating any lesion about the eye, we now apply a few drops of sterile castor oil under the lid, with consequent decrease of radiation damage to the sclera.

Pitfalls to be Avoided in the Roentgen Diagnosis of Intracranial Disease[1]

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TOO OFTEN, IN OUR enthusiasm for the positive side of diagnosis, we are apt to forget the equally important but less spectacular negative side, and because of this we may be led into considerable error. Hence, it may not be amiss to consider briefly some of the pitfalls of cranial diagnosis into which one can easily fall.

The first and most frequent "pitfall" is to attempt to draw conclusions from an inadequate set of films, or from those which are the result of poor technic.

We are all familiar with the fact that in about 50 to 60 per cent of adult skulls the pineal body will be calcified sufficiently to cast a shadow on the film, and most of us are aware of the methods in use for measuring its relative position. These methods are all based on proportional measurements, either mathematical or mechanical, and with either method we allow ourselves an arbitrary normal zone. If the pineal shadow falls within this normal zone, we usually feel a sense of relief and conclude that the gland is not displaced; if it is slightly out of this zone, we consider it displaced. In the vast majority of cases, these conclusions will be correct, but we cannot accept such a finding without careful consideration of each case as an entity. The reason for this lies in the fact that the pineal body may be shifted from one part of the normal zone to another without the measurements revealing such a shift. This normal zone is really too large for extreme accuracy; therefore, we must be careful to evaluate the patient as a whole before stating definitely that the pineal body is or is not displaced. Again, an innocuous anatomical variation may locate the pineal gland slightly outside the normal zone.

This discussion should not lead one to conclude that the use of our present schemes for pineal measurement must be abandoned. They are the best methods we have so far been able to devise and should by all means be used, but used with the full knowledge that they are not infallible and that we cannot accept the results with as complete assurance of accuracy as we can the reading of a thermometer. The discovery of a lateral pineal shift offers no problem in good films taken either anteroposteriorly or postero-anteriorly.

Another easy diagnostic pitfall is the misinterpretation of an anomalous configuration and distribution of circulatory channels. Not infrequently we will find the diploic venous channels to be larger than usual. This anomaly may be confined to the frontal, parietal, or occipital group of veins, or may involve all of them. In any case, the channels may all be large and tortuous, or some may be large and others small. When this problem confronts us, we must carefully compare both sides of the head since the condition is usually bilateral. If there seem to be more and larger venous channels on one side than on the other, it is probably of no more than passing interest, provided we are sure that the channels are venous. It is not difficult to differentiate between venous and arterial channels if we remember the origin of the arteries and that they tend to be less tortuous, to diminish in caliber toward their termini, and to end in numerous branches. It is indeed rare to find enlarged venous channels alone in association with cranial disease. In addition, if an area of hypervascularity of real pathological significance is encountered,

[1] Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942. The illustrations are from the teaching collection of the Neurological Institute of New York.

Figs. 1 and 2. Fig. 1 (above) shows normal diploic channels. Fig. 2 (below) shows abnormal vessel channels due to an arteriovenous angioma.

there will usually be some bone reaction in its immediate vicinity, such as spiculation or atrophy. A not uncommon fallacy is to consider large vessel channels the result of intracranial hemorrhage. Large vessel channels in a patient receiving a head trauma may be a factor in the production of hemorrhage, but inasmuch as most dural and subdural hemorrhages are from vessels within the meninges, it is readily understood that vessels within the diploe will have relatively little to do with the production of such hematomata.

Our chief interest in large vessel channels is to be able to warn a neurosurgeon that such vessels are in the operative field, or to be better able to predict the probable course of infection should a fracture or wound become infected. To be considered really hypervascular, an area must be hypervascular in comparison to other parts of the same head, and not in comparison to whatever model we may have set up as our standard.

Another anatomical area in which we may find difficulty in recognizing an abnormality is the diploe or middle table of the calvarium. The diploe may be coarse or fine, plentiful or sparse, evenly distributed or irregular in its distribution without being of any pathological significance. Not infrequently the diploe in the parietal areas will differ considerably from the same structure in the frontal or occipital region in the same skull, so that we must be familiar with the normal variations in order to be able to exclude such pathological conditions as osteitis deformans, osteofibrosis, infections, or other conditions due to nutritional disturbances.

Normal fine diploe will appear as a lacelike net within the calvarium. It will be clearly delineated, as are small uninfected mastoid cells, and will be continuous throughout the bone, being interrupted only by vessel channels and perhaps an occasional convolutional impression. It is this type of diploe that can at times mislead one into considering the appearance of the calvarium as granular, thus arousing suspicion of the presence of basophilism, hyperparathyroidism, or other disturbances of calcium metabolism. In such pathological conditions, the inner and outer tables, together with the bones of the base, would be lacking in bone calcium and the diploe would stand out in greater contrast than would be the case in the presence of normally calcified calvarial tables. It is true that the changes mentioned are in degree only and therefore at times offer us one of our most difficult problems of differential diagnosis. If, however, we have a clear clinical picture of the patient before us, our problem will be somewhat simplified.

The coarse type of diploe, often limited to one bone or even part of a bone, may suggest bony spiculation, porosity, or fibrotic changes. Upon careful stereoscopic study it will be seen that normal diploe, however coarse, will be neatly encased within the inner and outer tables; there will be no roughening of the cortex, no increase in vascularity except, perhaps, the presence of venous lakes in conjunction with diploic veins, no fusiform diploic swelling, best demonstrated in tangential views, and no areas of destruction of the overlying or underlying tables. In the presence of disease, the trabecular configuration and regularity will be disturbed and disorganized.

Not infrequently, in lateral views of the skull, we will see fine lines within the calvarium at various angles to the plane of the vault. To the unwary these lines may suggest bony spiculations or even striations of the type seen in the erythroblastic anemias. The lines must be studied carefully in order to identify them and rule out pathological possibilities. They are caused by a particularly well serrated sagittal suture and will have a healthy bone appearance. An anteroposterior or postero-anterior view will usually help considerably in recognizing the true significance of these at times puzzling lines.

The sutures are occasionally confusing and may be sources of error in diagnosis. We must remember that the occipitosphenoidal suture may occasionally remain

open until the age of about twenty years. It must not be considered evidence of a fracture, an easy pitfall if trauma has occurred. The short anterior branches of the inferior portions of the lambdoid sutures are often found to be asymmetrical. One will be seen to be less well approximated than the other. This again is easily misinterpreted as evidence of a fracture. It is well to remember that, to all intents and purposes, we can consider the skull as a sphere; it then becomes evident that to separate a small area without depression or splintering would be very difficult and would deform the entire sphere. Hence, when we see an area of real separation and on careful study find no depression, atrophy, or comminution, it is highly probable that we are dealing with a normal condition or a normal variant rather than an actual abnormality. Double suture lines must not be considered as evidence of fracture. The suture lines of the inner and outer tables occasionally do not coincide, so that an extraneous line may appear to run through the suture. A careful study of stereoscopic films will usually permit us to evaluate properly such an anomaly.

There are several anatomical variants which can easily mislead us unless we are careful, such as nature's trick of occasionally permitting the malar bone to originate from two or three centers of ossification. This type of development can easily simulate fractures, especially if we suspect trauma to that portion of the skull. A congenital lack of a superior orbital plate may appear very significant to the unwary, but a careful study of the margins of the "defect" will show that it is composed of healthy bone, which should dispel our fears. We must bear in mind, when examining skulls, that various anatomical anomalies can and do occur.

Convolutional impressions are often misinterpreted as evidence of intracranial pressure when in reality they are quite innocuous. There seems to be a widespread impression that whenever the inner table of the vault presents the appearance of "beaten silver," whether the likeness is exact or remote, it indicates an increase of intracranial pressure. First of all, we must be sure that we are dealing with real convolutional impressions. To be actually what they seem, they must conform to the anatomical configurations of the cerebral convolutions; otherwise, they are not convolutional impressions and are probably caused by some such condition as lacunous osteoagenesis, dysostosis cleidocranialis, or even leptomeningeal cysts, all of which are pathological or variants of clinical significance.

Fig. 3. Double suture line. This is not to be confused with a fracture passing through the suture.

True convolutional impressions are frequently seen in young people and occasionally in older patients in the temporal and occipital regions, without being of pathological significance. In fact, the number and depth of the convolutional digitations may vary widely within normal limits, and for this reason we must be careful not to misinterpret their significance. If the convolutional markings are the result of an increase of intracranial pressure, the interconvolutional ridges will lack calcium. They will appear atrophic and it is highly probable that other signs of increased pres-

sure will be recognizable, since deepening of the convolutional markings does not become evident until the pressure has been elevated for some time. Too many factors enter into the production of convolutional markings to make it possible to state how long after the onset of pressure they will be demonstrable in the film, but it seems safe to say that on an average, in the case of a child, several weeks would elapse, and in an adult at least two or three months, depending upon the thickness of the skull. An increase in depth and number of these markings can also occur in the presence of some of the malacic disturbances of bone which involve a variation of calcium metabolism. Often we will find the convolutional impressions delineated by healthy looking bone forming the interconvolutional ridges. This may well be of historical interest and indicate that, at one time in the past, pressure was a factor, or some metabolic or nutritional disorder played a leading role, but has since become corrected. Therefore, we must carefully weigh the evidence before interpreting convolutional digitations as being of clinical significance.

Another frequent source of error in intracranial diagnosis is the misinterpretation of a demineralized sella turcica as evidence of pressure atrophy, when actually it may be due to a congenital lack of bone calcium or to an abnormality of calcium metabolism of systemic origin, or to a normally thin bone. This again emphasizes the importance of always considering the general physical status of the patient when interpreting roentgenographic changes. We should remember that the roentgenogram, in the final analysis, is but a link in the chain of evidence, albeit an important one. In order to differentiate between demineralization due to pressure and that due to metabolic disturbances of systemic origin, we must carefully study the cortex of the bone forming the posterior clinoid processes and dorsum sellae, since it is in this portion of the skull, as a rule, that atrophy first becomes apparent. If the cortex is less dense than the cortex of the adjacent bony structures, particularly if it is less dense than the central portion of the bone, we are almost certainly dealing with atrophy. This change may at times be difficult to recognize, particularly if it

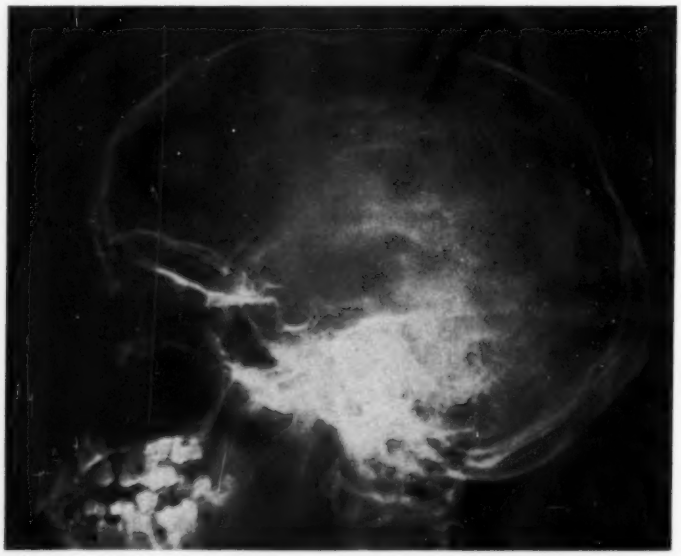

Fig. 4. Convolutional impressions not due to an elevation of intracranial pressure. Note the clarity of outline of the interconvolutional ridges.

is just beginning and if the dorsum sellae is invaded by a sphenoid air cell. Usually it can be recognized, however, if we are careful to compare the entire bony structure of the skull with that of the sella turcica, bearing in mind that the patient's general condition may be the cause of a demineralization which would not primarily affect the cortex.

It is well to remember, as pointed out above, that in the sella turcica it is the posterior clinoids and dorsum sellae that usually first show signs of pressure atrophy; then the floor will lose bone calcium, and lastly the anterior clinoids and tuberculum sellae will become atrophic. This is because the anterior clinoids are somewhat protected by the diaphragma sellae. A consideration of this chain of events will not infrequently permit us to state whether or not we are dealing with an early process. We must not be misled in making such an estimate in the presence of a massive floor under which there are no air cells. Obviously under such conditions cortical atrophy might be difficult to recognize; in fact it does not develop as readily as it would if the floor were thin.

Symmetry of the skull is never perfect, so that we must be wary in interpreting asymmetry as abnormal. This is particularly true of the petrosa. About 10 or 15 per cent of skulls show congenitally asymmetrical petrous pyramids, one being aerated in a comparatively normal manner while the other contains very few air cells. Usually the one with no air cells will be smaller, so that we will have a clue as to the real situation and not call such a condition evidence of old infection, as is so often done. Asymmetry may, however, be of considerable clinical significance, as when it is the result of agenesis or hypoplasia of one cerebral hemisphere. This condition is seen at times in patients suffering from some form of convulsive disorder. Dyke, Davidoff, and Masson a few years ago described this condition and

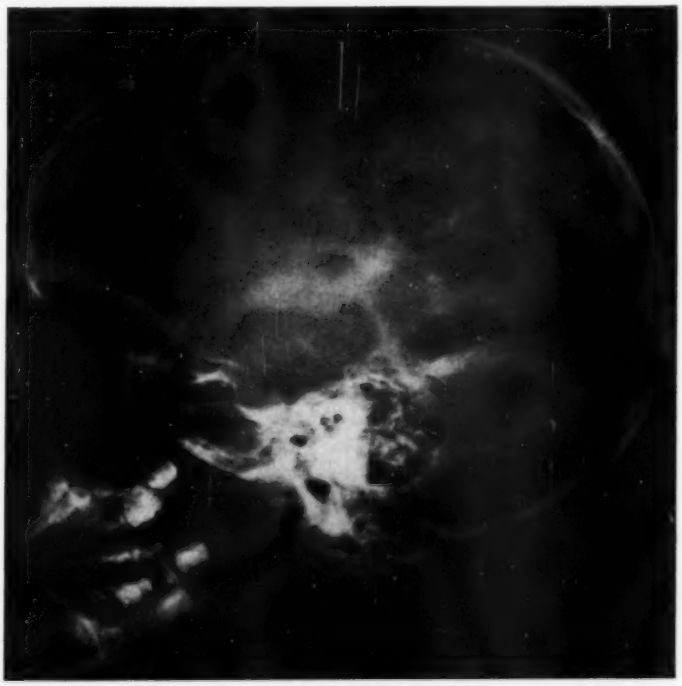

Fig. 5. Convolutional impressions due to an increase of intracranial pressure.

Fig. 6. Lacunous osteoagenesis (Lückenschädel). The defects in the bone are not due to convolutional impressions.

Fig. 7. An interesting anomaly consisting of a canalization of the middle meningeal vessel channel.

demonstrated the cerebral asymmetry by encephalography. This particular type of asymmetry is characterized by large supraorbital ethmoid cells on one side, which have developed at the expense of the cranial capacity. The petrous pyramid on the same side will be larger and the ridge higher than its counterpart of the opposite side, and in addition the calvarium will usually be thicker on the side of the smaller hemisphere. Asymmetry of the frontal cells is not of much importance, but the size and shape of the frontal cells may offer us a clue as to the endocrine status of the patient.

The mistake must not be made of drawing conclusions from a study of only one part of the skull. Every structure must be carefully studied and evaluated with reference to the whole. In this way only can we learn all that the films can teach us about the individual in question. Above all, we must not make the mistake of concluding our search after finding one abnormality, for not infrequently the same skull will contain several, and all or none may be of clinical significance.

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Developmental Thinness of the Parietal Bones[1]

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A VARIATION IN the appearance of the parietal bones encountered during the examination of roentgenograms of the head is a condition which is probably best described as "developmental thinness of the parietal bones." By this is meant the presence of an area near the superior margin of both, or less commonly one, of the parietal bones which appears to interrupt the normal smooth convexity of the parietal eminence and form a shallow depression involving about a fourth of the area of the parietal bone. It is manifested by a partial or complete absence of the diploe of the calvarium at the site and by a corresponding thinness of the skull in the involved portion. Less often the defect may assume the configuration of a parietal groove or sulcus. Known to anatomists and pathologists, it has escaped the attention of roentgenologists, as judged from the scant mention it has received in roentgenologic literature. In our experience the condition is fairly common and it is of interest because it may be confused with pathologic conditions.

A number of names have been given to this finding. Among these are "Involutionskrankheit" (Virchow), "senile atrophy" (Humphry), "symmetrical depressions" (Shepherd), "symmetrical atrophy" (Hollander), "symmetrical thinning" (Smith), "parietal impressions" (Piersol), and "symmetrical thinness of the parietal bones" (Greig).

Excellent reviews of the subject have been made by Chiari and also by Greig. To our knowledge, however, little has been written concerning the roentgenologic aspects of developmental parietal thinness. Redlich and Schüller, as early as 1910, described a parietal defect found in a roentgenogram of the head, which probably was developmental parietal thinness. In America, Holmes and Ruggles, Sante, and Pancoast, Pendergrass and Schaeffer have mentioned the condition, noting its rarity. Moore published a report of a case in 1929. Kasabach and Dyke included at least one case of developmental parietal thinness under the title of "osteoporosis circumscripta" in a report made in 1932. In the discussion of a paper on enlarged parietal foramina by Pepper and Pendergrass in 1936, Sosman and Pepper mentioned the change we speak of. Occasional reports of cases can be found in the foreign literature.

There are essentially two types of developmental parietal thinness, the flat type and the grooved type as seen in the postero-anterior projection. The involvement is usually bilateral and symmetrical; unilateral changes occur less often. An area of decreased density corresponding to the involved region is demonstrable in the lateral projection of the head. There is usually a smooth progressive thinness from the periphery of the involved area to its center. Typically, the diploe is lacking at the site of thinness. The external table is thinned and depressed. Some authors, among whom are Smith, Durward, Pancoast, Pendergrass and Schaeffer, and Schmidt, think that the inner table may likewise be affected. In our cases of developmental parietal thinness, we did not find involvement of the inner table.

[1] Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill. Nov. 30–Dec. 4, 1942.

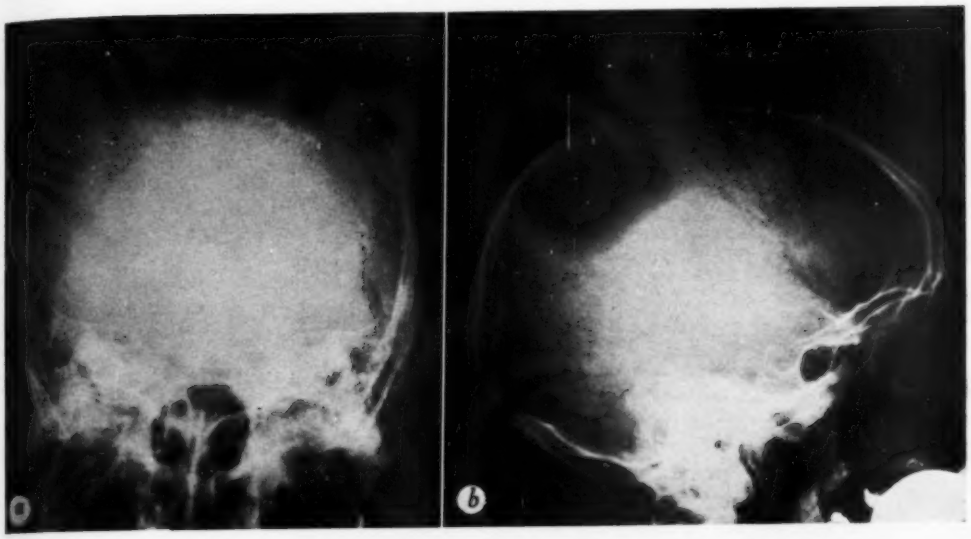

Fig. 1. Flat type of developmental parietal thinness: postero-anterior and lateral views.

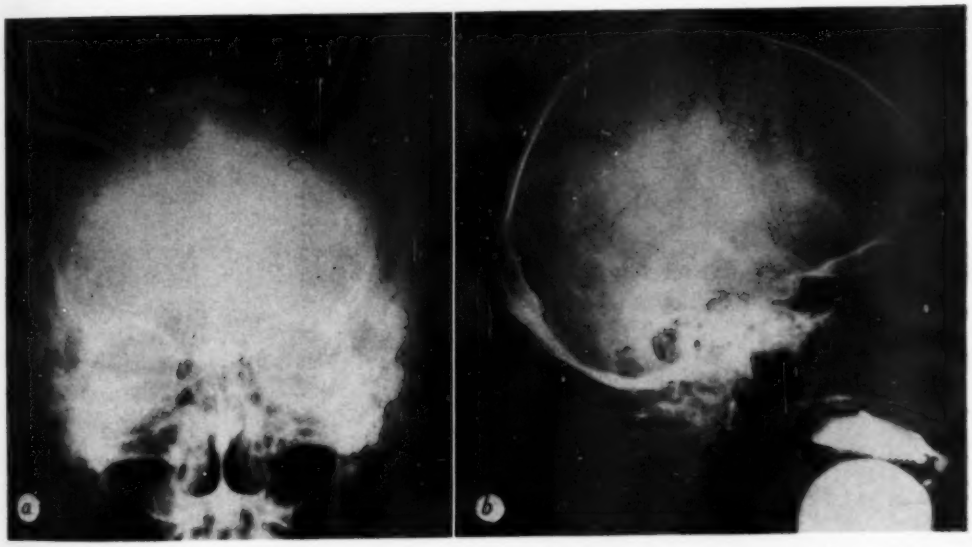

Fig. 2. Grooved or sulcus type of developmental parietal thinness: postero-anterior and lateral views.

It is not necessary to deviate from the conventional lateral and postero-anterior roentgenograms of the head to demonstrate this condition. One may, of course, show it better with tangential views over the involved portion of the skull. Often, better definition of the lack of diploic structure and the thinness can be obtained by examining the roentgenogram by means of a small bright lamp instead of a roentgenographic viewing box.

We have reproduced in the accompanying illustrations, roentgenograms of the common types. The flat type is seen in Figure 1. The less common grooved or sulcus type of developmental parietal

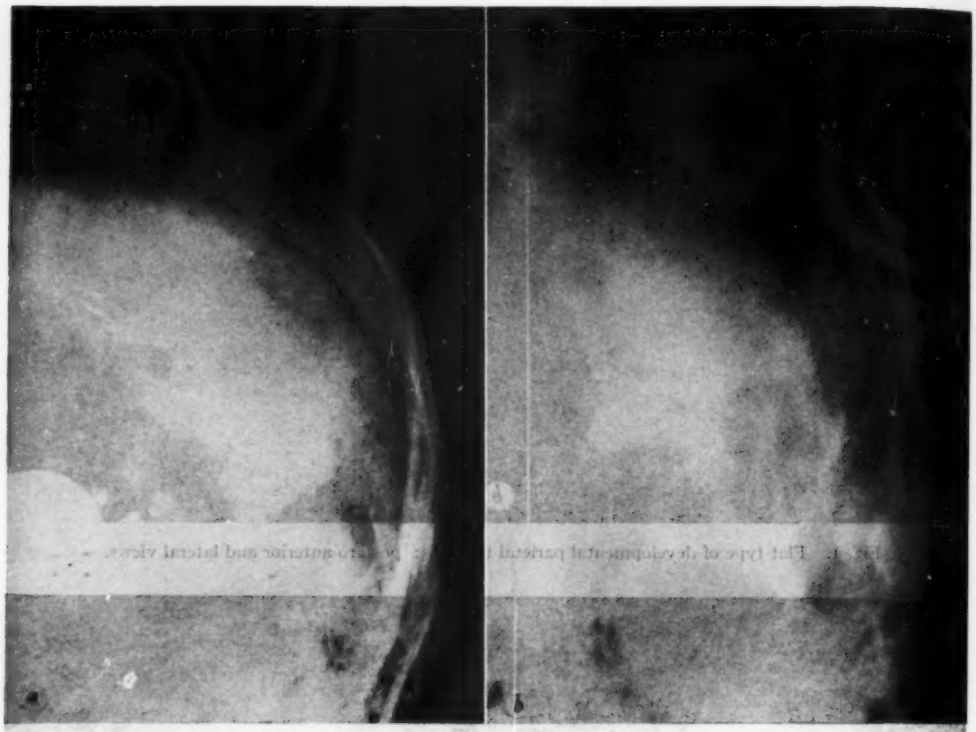

Fig. 3. Enlarged views (postero-anterior) of the flat (*a*) and the grooved (*b*) types of developmental thinness of the parietal bones.

thinness is seen in Figure 2. Enlargements of the involved portions shown in Figures 1 and 2 are reproduced in Figure 3. Self-explanatory sketches of the changes in typical roentgenograms are given in Figures 4 and 5. An artist's conception of the changes as seen in a vertical view of the skull is also presented.

Virchow, Maier, and Rokitansky were pioneers in the pathologic concept of developmental thinness of the parietal bones. Of the more recent contributors to the pathology of the lesion, Schmidt presented his views concerning the condition in a work dated 1937. His description of the gross changes conforms to those given in previous paragraphs, except that he stated that in the extreme form the changes may involve the inner table of the calvarium and expose the dura. We did not observe this finding. According to Schmidt's descriptions of microscopic sections of these regions, the inner table of the skull is usually seen to be intact, the diploe is progressively thinned toward the center, the diploic spaces are diminished in size, and the external table is represented by a thin line of compact bone. The periosteum is intact on both sides of the calvarium.

Schmidt expressed the opinion that the changes encountered in developmental thinness of the parietal bones represent a special type of senile osteoporosis and that the condition is progressive. He did admit that it occurs in younger people, but considered that such cases belong to an exceptional type of senile osteoporosis. On the other hand, Greig, who has made rather extensive studies of museum skulls, believed the changes to be due to some altered physiologic process of bone, but considered the finding, as we know it, not progressive but static.

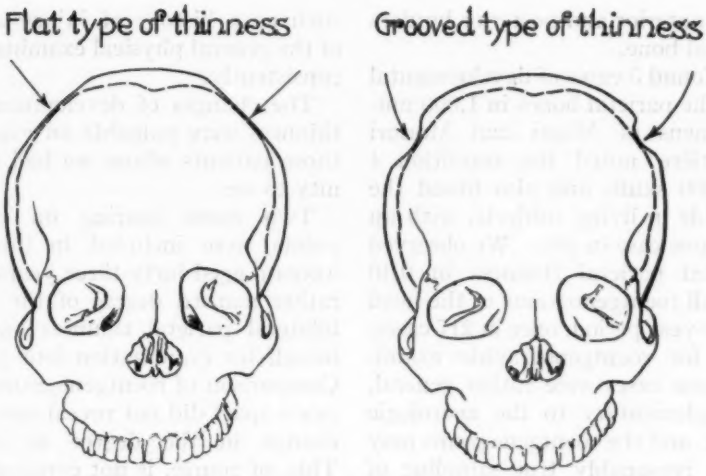

Fig. 4. Sketches of the changes of developmental thinness of the parietal bones.

Many hypotheses have been suggested in the past as to the causation of developmental thinness of the parietal bones, which are too numerous to mention at this time except for the idea, commonly accepted in the latter part of the nineteenth century, that it is a disease of old people, particularly of elderly women.

We have selected 119 examples of developmental thinness of the parietal bones from the files of the Section on Roentgenology of the Mayo Clinic for analysis. Variation in the appearance of the findings was noted. The bilateral flat type of developmental thinness of the parietal bones predominated, occurring 98 times in the 119 cases. Of the remaining cases, 9 were of the bilateral grooved type, 8 were of the unilateral flat type, and in 3 there were unilateral parietal grooves. One case was of a mixed type, presenting both a flat and grooved defect. Thus approximately 80 per cent of all of the roentgenograms studied in this analysis presented the bilateral flat type of developmental thinness of the parietal bones. In these, typically, the thickness of the calvarium at the site was reduced to about a half of the thickness of the adjacent uninvolved bone. In these typical cases, the affected area was 5 to 10 cm. in length in the sagittal plane as seen on the lateral roentgenogram and

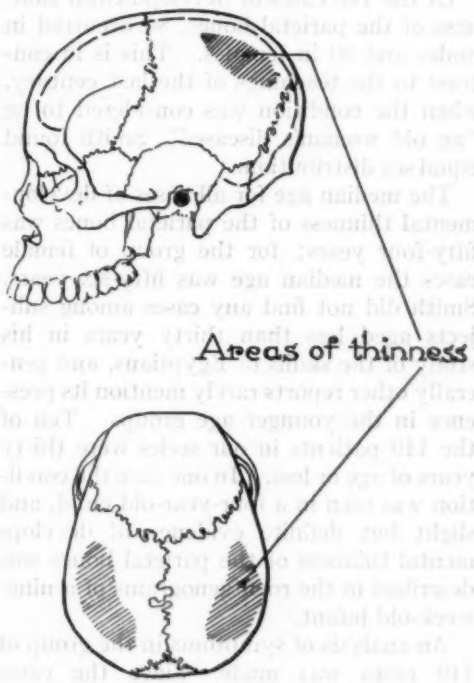

Fig. 5. Areas of thinness in the skull.

from 3 to 4.5 cm. in width. The areas were located above the superior temporal line, and the upper limits did not reach the sagittal suture in any case. The center of the area of thinness was usually midway

between the anterior and posterior borders of the parietal bone.

Durward found 5 cases of developmental thinness of the parietal bones in 1,000 museum specimens of Maori and Moriori skulls. Carrière noted the condition 4 times in 1,000 skulls and also found the lesion palpable in living subjects, with an incidence of one case in 406. We observed developmental parietal thinness in 0.46 per cent of all roentgenograms of the head during a two-year period, once in 217 cases. Indications for roentgenographic examination in these cases were rather general, mostly complementary to the neurologic examination, and the roentgenograms may represent a reasonably true sampling of patients.

Of the 119 cases of developmental thinness of the parietal bones, 80 occurred in males and 39 in females. This is in contrast to the teachings of the last century, when the condition was considered to be "an old woman's disease." Smith found equal sex distribution.

The median age for all cases of developmental thinness of the parietal bones was fifty-four years; for the group of female cases the median age was fifty-six years. Smith did not find any cases among subjects aged less than thirty years in his study of the skulls of Egyptians, and generally other reports rarely mention its presence in the younger age groups. Ten of the 119 patients in our series were thirty years of age or less. In one case the condition was seen in a four-year-old child, and slight but definite evidence of developmental thinness of the parietal bones was described in the roentgenograms of a nine-week-old infant.

An analysis of symptoms in the group of 119 cases was made. Since the cases were referred largely from the Section on Neurology, a large percentage of the patients had headache. We were not able to correlate this symptom with developmental thinness of the parietal bones, since the headache was due to other causes. This was also true of vertigo, tinnitus, and psychic symptoms. Other clinical points, such as a history of injury and findings of the general physical examination, varied consistently.

The changes of developmental parietal thinness were palpable on examination in those patients whom we had an opportunity to see.

Two cases bearing on controversial points were included in this study. A woman, aged forty-three years, who had a rather marked degree of the flat type of bilateral parietal thinness had presented herself for examination four years before. Comparison of roentgenograms taken four years apart did not reveal any appreciable change in the degree of involvement. This, of course, is not conclusive evidence against the progressive nature of the condition; we merely cite it as an interesting observation. Another woman, aged seventy-three years, with whom we spoke recalled that her mother had likewise had grossly palpable bilateral parietal thinness. Since the condition is not familiar to most physicians and patients are rarely aware of any change in the contour of their calvaria, our attempt to determine any familial tendency except in the foregoing instance did not produce any definite results.

Thus, as far as we know, developmental thinness of the parietal bones is clinically not very important. It appears to be due to diploic dysplasia. In diagnostic roentgenology the lesion does assume a role of importance in so far as it may be misinterpreted as some other condition, as osteolytic metastatic carcinoma, myeloma, lymphomatous involvement of the calvarium, xanthomatosis, epidermoid tumor (cholesteatomas), osteoporosis circumscripta, enlarged biparietal foramina, secondary changes of a neoplasm of the scalp or inflammatory lesion of the scalp, osteomyelitis, postoperative changes, trauma, and localized absorption of bone due to unknown causes. The characteristics of these other conditions need not be reviewed here.

We have chosen to describe our findings in this series of 119 similar and related parietal lesions as "developmental thinness of the parietal bones" in contrast to

"symmetrical thinness," because of its occurrence in younger age groups than ordinarily described, and have droppped the term "symmetrical" since in a significant number of our cases the changes were unilateral. We have subscribed to the hypothesis of the static nature of this variation, so far as we designate it as "thinness" rather than "thinning," and are of the opinion that it is not progressive, since our younger patients displayed degrees of involvement similar to those of the older groups. Further, we did not find any cases in which there was thinness of such a degree as to be classed as a parietal foramen. We are familiar, as are others (Paterson and Lovegrove), with this latter variation, the so-called biparietal foramina, and feel that it is unrelated.

Remembering the roentgenographic characteristics of developmental thinness of the parietal bones, there should be no difficulty in recognizing it. We feel that its greatest significance is in knowing it as an incidental variation which might be confused with a pathologic change in the calvarium.

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Roentgen Therapy of Pelvic Tuberculosis in the Female[1]

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IN REVIEWING the work that has been done in the roentgen therapy of pelvic tuberculosis in the female, one is impressed by the scant concern with it in this country, as compared with its wide utilization in continental Europe and the extensive literature arising therefrom. In the United States the effect of x-ray treatment on tuberculous granulation tissue in general, and on tuberculosis in other locations, such as lymph nodes, has received fair attention. As to tuberculosis of the female reproductive organs and pelvic peritoneum, a few writers have reported a few cases, but there have been no large series. Ford (1) lists 35 cases of abdominal and pelvic tuberculosis, of which 7 were in the female generative organs. Polak (2), reporting on subacute adnexal inflammations treated with x-rays (castration), states that 8 of the cases in his series were tuberculous. An article by Schmitz (3) emphasizes chiefly carbon-arc therapy, although x-ray irradiation is mentioned. Jameson (4) and Lenz and Corscaden (5) review the literature and report 2 and 3 cases, respectively. The predominance of German literature on the subject is illustrated by a long and comprehensive article by Bickenbach (6), at the end of which he lists 258 references exclusive of abstracts, of which all but twenty-two are German. The majority of the latter are French. To be sure, not all of these articles deal primarily with the x-ray treatment of pelvic tuberculosis. Some are on the more general subject of the handling of pelvic tuberculosis, operatively and otherwise, while some discuss the effect of x-rays on tuberculosis in general. Nevertheless, judging by this compendium and other literature, the interest of German workers seems to have outweighed that of other countries ten to one.

In 1898 Ausset and Bédart (7) reported the successful treatment of a case of peritoneal tuberculosis which had proved resistant to other forms of therapy. In 1907 Bircher (8) reported 26 cases of tuberculous peritonitis improved or cured by x-ray. Spaeth (9), in 1911, cured a hopeless case of genital tuberculosis, and other reports appeared around that time. After this the method seems more or less to have fallen into disuse for ten years. According to Bickenbach, it has been "forgotten again and again," only to be rediscovered or revived in this or that clinic. The greatest interest, as judged by published articles, was shown in the years fom 1921 to 1936. An incomplete but fairly extensive search of foreign irradiation literature from 1938 through 1941 shows not a single original article on the subject.

The effect of x-rays upon tuberculous granulation tissue has been considered extensively in both American and foreign literature and will not be dealt with here. Instead I shall attempt to assay the clinical advantages of x-ray therapy as against surgery or accompanying it, discussing briefly the experiences and technics of various workers and adding a few illustrative case reports.

The term genital tuberculosis in the female properly refers to tuberculosis of the vulva, vagina, uterus, ovaries, and tubes, but as disease of the pelvic peritoneum is such a frequent accompaniment, particularly of tubal involvement, it also will be included. Tuberculosis of the vulva, vagina, and cervical lip is rare, and involvement of the ovaries is also infrequent, being found but three times in a series of 94 cases of pelvic tuberculosis at the Woman's Hospital in New York. I have

[1] From the Woman's Hospital, New York, and the N. Y. Infirmary for Women and Children. Read in part before the New York Roentgen Society, May 17, 1943. Accepted for publication in August 1943.

found but one report of involvement of Bartholin's glands. Disease of the endometrium alone is unusual. Novak (10) states that almost without exception it is secondary to disease in the tubes and he considers that one is justified in assuming tubal involvement where curettage reveals endometrial tuberculosis. Conversely, Bickenbach says that the endometrium is found to be diseased in 50 to 70 per cent of cases of tubal involvement. The commonest types of the disease in the female pelvis are tuberculosis of the tubes and of the pelvic peritoneum, or a combination of the two. Jameson reports that over 90 per cent of the tubal cases are bilateral.

Schmitz states that 3 per cent of female cadavers show genital tuberculosis and that 10 per cent of chronic tubal inflammations are tuberculous. Lenz and Corscaden report that of 850 cases of chronic pelvic inflammatory disease examined microscopically in their institution, 41 were tuberculous salpingitis. An extremely low incidence is found at the Woman's Hospital where, in the years 1929 to 1942 inclusive, there were 27,160 gynecological admissions, and only 94 cases of pelvic tuberculosis.

SURGERY AND IRRADIATION

Only surgical and radiation therapy will be considered here. The surgical approach is in general of two types: conservative, removing only diseased tissue, and radical. Jameson states that the principal objection to conservative surgery is the impossibility of determining the extent of disease macroscopically. Other surgical procedures are aspiration of ascitic fluid and laparotomy for diagnosis and for the removal of fluid and pus. X-ray procedures include primary x-ray treatment, irradiation following conservative and radical surgery and surgical drainage, and irradiation of recurrences. Primary x-ray treatment I consider of limited value, as in the majority of cases some sort of surgical procedure will always remain obligatory for diagnosis. The irradiation treatment of undiagnosed pelvic conditions on a supposition based on the presence of tuberculosis elsewhere seems completely unwarranted. Except for endometrial biopsy and the occasional opportunity for an external biopsy, as from a fistulous tract, there is no way to make an adequate diagnosis except by curettage or by exploratory laparotomy.

Once having determined the presence of the disease, what is the proper use of x-ray therapy and what is its value weighed against further surgery or combined with it? Gauss (11) and Gal (12) both believe that early, limited, circumscribed cases do equally well with surgery or irradiation, while late cases respond poorly to either. This is reasonable but obviously leaves the largest, intermediate group for further judgment and disposal. It will be shown below that clean, apparently successful operative removal may be followed by recurrence, for which x-ray therapy is often strikingly effective. Surgeons usually prefer to operate in the operable cases, from mental habit and because, even when aware of the successes of x-ray in the field, they consider surgery a shorter procedure for the patient than long-drawn-out multiple irradiation cycles. Against surgery is the operative mortality (7 to 8 per cent according to Lenz and Corscaden), the occurrence of postoperative fistulae, estimated at 5 to 10 per cent, the possible production of miliary tuberculosis, the danger of injury of the bladder and rectum during the operation, as the line of cleavage is sometimes hard to find, and the likelihood that structures left behind may already be invaded by tuberculous granulations. X-ray treatment has no effect on pyosalpinx, ascitic fluid, or abscess material. It should be absolutely avoided in pregnancy. In peritoneal tuberculosis it is most successful in the dry form with moderate plastic exudate, but it is also useful postoperatively after fluid and non-viable debris have been removed. Protection of the ovaries in the child-bearing period should be considered in deciding on the type of treatment and, if x-ray is used, in planning

the dosage, although some consider this unimportant on the ground that patients with pelvic tuberculosis are likely to be sterile or, contrarily, that pregnancy is undesirable for them. In cases of mixed infection, tuberculous and other types, the individual case must be considered on its merits, as a candidate for one or the other type of treatment.

When disease of the endometrium alone is diagnosed, by biopsy or curettage, and there are no symptoms referable to the tubes or peritoneum, it is probably best to try x-ray as a primary procedure, including the tubes in the treated field because of the probability of at least minimal disease there. When frankly diseased tubes are diagnosed at operation, their removal followed by irradiation is usually the method of choice. In advanced tubal-peritoneal disease the combined treatment is also preferred, with laparotomy for diagnosis and removal of fluid or necrotic tissue where present, followed by x-ray therapy. The worst prognosis is found in cases of severe disease elsewhere, either in a supposedly single focus or generalized, although these patients, if not too badly off, frequently benefit from palliative treatment of their pelvic symptoms.

CONSIDERATION OF RESULTS

Attempts to assess results from various clinics prove difficult because of the varying and often indefinite criteria for success, and indeed sometimes for diagnosis, Cases are reported "improved" or "cured" with lines between these results not clearly drawn. Bickenbach does not consider a patient cured until she has "lived a normal life for three years." But what is a normal life, in respect to genital tuberculosis? Döderlein (13) states that "actual cure in the anatomical and biological sense cannot be established in genital tuberculosis. All that can be done is to note subjective improvement, increase in bodily strength, etc." More solid ground is reached where a palpable mass actually disappears under x-ray treatment, or a series of endometrial biopsies shows improvement in a lesion.

TABLE I: RESULTS OF DIFFERENT TYPES OF TREATMENT
(Summarized from Five Tables by Bickenbach)

Type of Treatment	Contributing Authors	Total Cases	Cured or Improved
Operation and postoperative x-ray therapy	9	158	106(67%)
X-ray therapy only	14	309	243(78.5%)
X-ray therapy following exploratory laparotomy (including removal of fluid)	7	150	120(80.5%)
Operation only (before 1912)	6	165	113(68.5%)
Operation only (1925–33)	4	128	76(59.5%)

Bickenbach warns that we should not attempt to compare surgical and x-ray treatment results unless we note the degree of disease and recommends the classification of cases for statistical purposes as localized, advanced, and hopeless. But such classification is too seldom available to influence greatly the comparison of results or any deductions as to treatment principles.

Among the largest of the x-ray series is that of Wesseling (14), consisting of 115 cases—65 adnexal, 35 adnexal and peritoneal combined, 15 in other locations—of which 66 were reported cured and 24 improved. Gragert (15) reported 44 cases, with 22 cured, 9 improved, 5 dead, and the remainder not followed. Out of a total of 79 cases, Gal irradiated 25, with 6 "healed," one up to twelve years, and 8 "apparently healed." Bickenbach collected from the literature the remarkable number of 910 cases of female pelvic tuberculosis, of which 617 were irradiated. Two hundred and ninety-three had surgical treatment only and are used for comparison. It seemed of some interest to summarize his totals as given in a group of five tables (Table I). These totals are gross figures, uncorrected for short periods of observation or death from other causes (both of which are included in the original tables). Since separation of "cured" and "improved" is made in some tables and not in others, I have combined the two columns for uniformity. The separate columns

may be found in the original text. These results offer a brilliant showing in favor of x-ray treatment but, as is so often the case in statistical presentations, there are unknown and qualifying factors which cannot be dug out in numbers commensurate with the statistics themselves.

TECHNIC

The discussion of technic to follow refers exclusively to x-rays, though radium is sometimes used. Gal prefers radium in portio and endometrial tuberculosis, and x-rays in the adnexal-peritoneal combination. I have had no experience with radium. For x-ray technic, dosages recommended by various workers run all the way from the old "tuberculosis dose" of Seitz and Wintz, of 50 per cent (or 54 per cent) effective in the tissues, to the 5 per cent E.D. which, according to Bickenbach, Seitz later gave. Bickenbach himself gives a 35 to 100 r tissue dose, with number of doses and time interval varied according to the needs of the patient. He recommends larger doses to produce freedom from pain quickly, and in fistulae, if there is no question of saving the ovaries, a 200 to 300 r tissue dose. Lenz and Corscaden recommend 75 r to an anterior abdominal field, adding a posterior field if the patient is fat. Their total dose varies but may run up to 750 r on the skin of the anterior abdominal wall over a period of ten weeks. An average dose for numerous workers seems to be 10 to 15 per cent E.D., repeated weekly two to four times, and with several cycles at monthly or longer intervals.

Gauss has an elaborate system of 120 r (air) for the first dose, 100 r for the second, 80 r for the third, 60 r for the fourth, 40 r for the fifth, with a six-week interval between doses. This sounds like an extreme degree of attenuation at the end, particularly in view of the six-week intervals, but as he uses a 24 × 20-cm. field his initial dose is fairly high. Wesseling employs an abdominal and a sacral port, each 24 × 24 cm., obviously including much more than the pelvis itself. Martius (16) uses a very large anterior field, giving 150 r at a dose, with a total of three doses at intervals of eight days. These large portals are common, and should be thought of when comparison is made with technics where smaller portals are used. It is difficult to understand the popularity of these huge portals except in widespread peritonitis. They would not be applicable to such lesions as the small recurrent masses described below, and the entire uterus and adnexa may readily be irradiated through a field 16 × 12 cm. or less. Even in peritonitis, I prefer dividing the abdomen into smaller fields. It is more trouble, but gives a more uniform central ray dosage and seems to produce less nausea and intestinal gas than when the whole abdomen is rayed at once.

My dosage technic has changed somewhat over a period of years. Cases 2 and 10, treated about ten years ago, received 300 r in air at a dose, whereas more recent cases were given 75 to 100 r, following the general trend toward smaller doses, though some of my larger doses were successful. Treatments over the same field are not repeated oftener than once a week; treatment to different fields may be given two or three times a week if the portals are small. Possible variations in time spacing are illustrated in the cases reported below.

CASE MATERIAL

A résumé of my 11 cases is given in Table II. It is notable that every case showed more than one focus of disease. Cases 10 and 11 appeared at first to be confined to the peritoneum, but in Case 10 there was a recurrent mass, and in Case 11 a second operation showed widespread disease of tubes and endometrium. This multiplicity of foci in the pelvis is common. There were 4 cases of pelvic peritonitis. It is recognized that the mere opening of the abdomen in this condition may be beneficial or even curative, but this seems less likely where other organs are involved. The most interesting results in the group are in the 6 cases with pelvic masses, 3 recurring after radical surgery and all 6 disappearing completely after irradiation.

TABLE II.: RESULTS OF ROENTGEN THERAPY IN ELEVEN CASES OF PELVIC TUBERCULOSIS

Case	Location of Disease	Method of Diagnosis	Other Foci of Disease	Results	Followed After Irradiation
1. E. F.	1. Endometrium 2. Mass in rectovaginal septum	1. Endometrial biopsies 2. Palpation	Lungs and bone, healed	Clinically free of disease Mass disappeared	1½ yr.
2. J. A.	1. Both tubes 2. Endometrium 3. Recurrent mass after operation	1. Laparotomy 2. Curettage 3. Palpation	None found	Clinically free of disease. Mass disappeared	2½ yr.
3. F. A.	1. Both tubes (removed at operation) 2. Recurrent masses after operation	1. Laparotomy 2. Palpation	None found	Clinically free of disease. Mass disappeared	2½ yr.
4. D. R.	1. Endometrium 2. Mass in right pelvis (tube?)	1. Curettage 2. Palpation	None found	Clinically free of disease. Mass disappeared	2 yr.
5. D. E.	1. Endometrium 2. Bilateral pelvic masses (tubes?)	1. Curettage 2. Palpation	Lungs clear. History suggestive of peritonitis or salpingitis ten years before	Clinically free of disease. Masses disappeared	1 yr.
6. H. O.	1. Endometrium 2. Abscess opening into vagina (probably tuberculous salpingitis)	1. Curettage 2. Inspection	None found	Improved. General health good. Pelvic thickening remains	3 yr.
7. P. O.	1. Sinus draining into vagina (right) 2. Pelvic mass (left), assumed to be bilateral salpingitis	1. Biopsy 2. Palpation	None found	Slight improvement, but returned to surgeon for drainage, etc. (age 17)	4 mo.
8. K. E.	1. Peritoneum 2. Small intestine (moderate ascites)	1 and 2. Laparotomy and biopsy 2. Barium enema	Calcification in lungs	Striking improvement, but disappeared from follow-up	4 mo.
9. N. I.	1. Both tubes 2. Peritoneum	1 and 2. Laparotomy and biopsy	Lungs negative 6 months before treatment; 2 months after treatment bilateral pulmonary disease	Pelvic symptoms gone, masses almost gone at 2 months. Died from chest condition	6 mo.
10. A. L.	1. Peritoneum 2. Recurrent mass in rectovaginal septum	1. Laparotomy and biopsy 2. Palpation	Calcified scars in lungs	Clinically free of disease. Mass disappeared	3 yr.
11. F. O.	1. Peritoneum 2. Cervix 3. Endometrium and tubes (2 and 3 found 1½ years after 1)	1. Laparotomy 2. Biopsy 3. Laparotomy	Scars in lungs	Clinically free of disease 1½ years, when new lesions were found	1½ yr.

Four cases were symptomatically improved, but for various reasons were unsatisfactory in the end. One patient showed little improvement.

CASE I: E. F., age 39, had been at Saranac twelve years before admission, with tuberculosis of the lungs, one wrist, and the left sacroiliac joint. All the lesions had healed, the sacroiliac joint following fusion. On examination in the Woman's Hospital sterility clinic, the uterus was found normal in size, the adnexa normal. A small, hard, non-tender mass was present in the rectovaginal septum. Endometrial biopsy showed tuberculosis (Fig. 1A).

The patient was referred for x-ray therapy and received four weekly treatments of 150 r each (air), anterior and posterior fields measuring 10 × 16 cm. being treated alternately. A month after the last treatment the mass was 50 per cent smaller, the patient was gaining weight and having hot flashes, and a second endometrial biopsy was reported as "tuberculous endometritis, chronic, in a stage of fibrosis." A duplicate x-ray cycle was given three months after the first, and a month later a third

biopsy (Fig. 1B) was reported as "organized, scarred tuberculous granulation tissue." There was slight thickening in the rectovaginal septum. Four months later this had completely disappeared and the patient weighed 134 pounds, a gain of 12 pounds. No further biopsies were done, but the tuberculous process seems obviously to have been halted by the radiation, as evidenced by disappearance of the mass, gain in weight, and maintenance of good health for as long as the patient was followed, a period of one and a half years after the last treatment.

pelvic port 12 × 12 cm., and a week later the same dose through a right posterior port. A month after this the mass was smaller and the pain less, but at a second monthly visit the mass was larger and there was more pain. A second cycle of two treatments was given, with the same dosage as before. The result duplicated that following the first cycle, with improvement in the first month, not maintained during the second. After a third x-ray cycle the mass diminished slowly, disappearing completely after four months. The patient had no further symptoms during the two and a half years

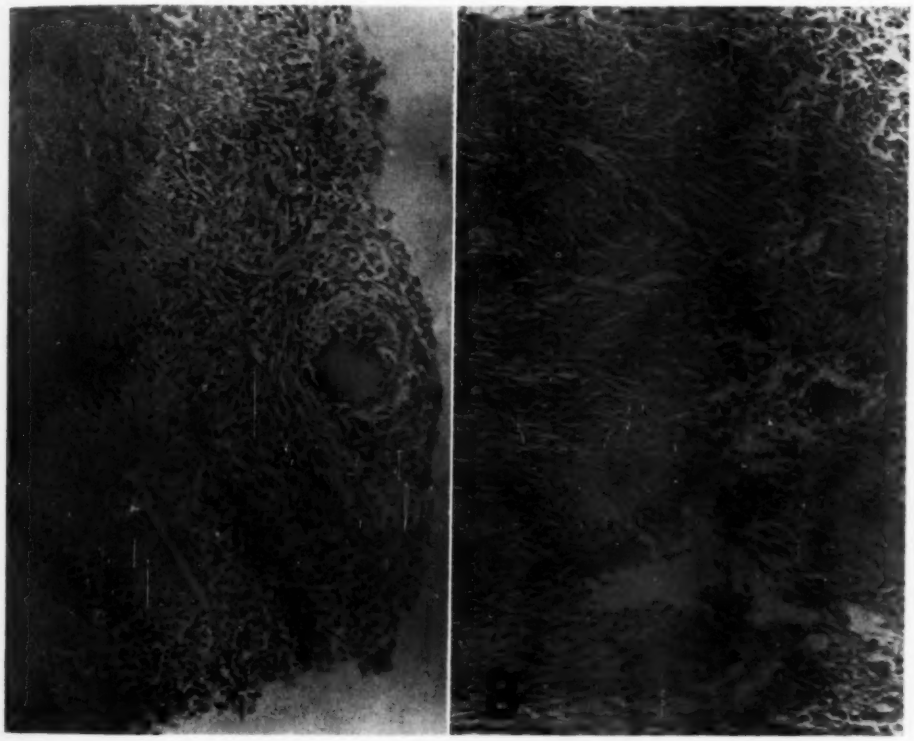

Fig. 1. Case 1: A. Endometrial biopsy made before x-ray treatment. B. Biopsy specimen one month after second x-ray cycle, four months after first cycle.

CASE 2: H. J. was admitted complaining chiefly of bleeding A diagnosis of pelvic inflammatory disease was made. Operation showed chronic inflammation of both tubes, a cyst of the left broad ligament, and all pelvic structures encased in veil-like adhesions. The procedures were preliminary curettage, bilateral salpingectomy, left oophorectomy, and removal of parovarian cyst. Pathological report: tuberculosis of the endometrium and both tubes. Recovery was uneventful, but two months later the patient returned to the clinic with severe pain in the right pelvis, where a mass 3 in. in diameter was found. She received 300 r in air to a right anterior she was followed. Here it took three rounds of x-ray at intervals of two months to effect permanent resolution of the mass and permanent cure of pain. The patient menstruated throughout the period of observation.

CASE 10: A. L., a Puerto-Rican woman of 50, was admitted to the Woman's Hospital for abdominal pain and distention. Operation showed thickened omentum and an extreme degree of adhesions involving it and multiple intestinal coils. The appearance suggested generalized carcinomatosis, and the abdomen was closed. The pathological report was tuberculosis.

The patient did poorly postoperatively. Pain, fever, and distention persisted and even increased. X-ray therapy was then instituted. The entire abdomen was divided into four anterior and four posterior fields and one field was treated every two to three days, each receiving 300 r, once around. Three weeks later a duplicate cycle was given. Two months after the second series of treatments the abdomen and pelvis were soft; some pelvic tenderness could be elicited, but no pain, and even the tenderness disappeared by the next visit. There were no further symptoms for six months, when the patient returned complaining of weakness and anorexia, abdominal and lumbar pain, and loss of weight. A soft, tender mass the size of a lime was found between the cervix and rectum. Two more cycles of x-ray, identical in pattern with the preceding except that the upper half of the abdomen was omitted, were given two months apart. Distention and weakness gradually diminished. The recurrent mass had disappeared four months after treatment, the abdomen was soft, there was no pain or tenderness, and there had been an appreciable gain in weight. The patient was followed for over three years from the last x-ray treatment, during which time there was no evidence of recurrence and she remained in good health.

Failure or partial failure is often more instructive than success and, with this in mind, a second case of pelvic peritonitis is reported, providing a comparison with Case 10 as to handling and outcome.

CASE 11: F. O. entered the Woman's Hospital because of a pelvic tumor. At operation the uterus was found to be converted into an irregular mass of fibroids the size of a four months' pregnancy. The entire visceral and parietal peritoneum was covered with innumerable yellowish-white nodules ranging in size from a pin point to a pea. Large and small intestine were densely adherent to each other and to the pelvic organs and similarly covered with nodules. The right adnexa were converted into a cystic mass the size of a lemon but not clearly seen because of adhesions. The left tube was covered with nodules, but the left ovary was normal in appearance. A frozen section was diagnosed as carcinoma and the abdomen was closed. The subsequent pathological report was chronic tuberculosis of the peritoneum with beginning caseation.

Two weeks later the patient was referred for x-ray therapy. The lower abdomen was divided into four fields, two anterior and two posterior, 10 × 16 cm. Each field received 200 r (air) at a dose, two fields a week being treated, going three times around, so that 12 treatments, and 600 r per field, were given over a period of six weeks. Pain and tenderness subsided rapidly and were almost gone at the end of the x-ray treatment. Six months later the only abnormality remaining was the fibroid. The patient had not menstruated since one month after treatment. She felt so well she had taken a job as a presser. Six months later she was still feeling well and was employed at the same job. One and a half years after treatment she had no complaints, but a small, eroded, nodular area was discovered on the cervix. A biopsy showed tuberculosis. As the fibroid also seemed larger, it was decided to do a hysterectomy. At the second operation large, multiple, pedunculated and intramural fibroids were found. There were numerous small white nodules on the peritoneal surfaces of the small bowel, but the widespread peritoneal disease seen at the first operation was not present. A complete hysterectomy and bilateral salpingectomy were done. The microscopic pathological report was: "scattered tubercles in endometrium, none in myometrium. Cervical mucosa obliterated in part and replaced by compact masses of tuberculous tissue. Both tubes contain densely aggregated masses of tubercles, some of them having undergone caseation and necrosis. Nothing but fibrosis found in ovaries." Sections of peritoneum showed scarring of old disease, presumably post-irradiation.

This case raises interesting questions impossible to answer. I feel that the patient should have had one or two more cycles of x-ray therapy, but it is doubtful if that alone would have controlled the disease, because of the strain of her employment. After the first cycle she stayed at home for a while, but then felt so well that she took a job, the nature of which was not known at the clinic at the time. It seems amazing that she remained free of symptoms for a year and a half, as long hours on one's feet ironing in an over-heated room is certainly not regulation convalescent treatment for tuberculosis. In spite of this, the lesions found at the second operation were not so extensive as at the first, indicating considerable benefit from irradiation. The present plan is for the patient to receive more x-ray treatment, a longer rest period, and if possible less taxing work later.

SUMMARY

The status of irradiation treatment of pelvic tuberculosis in the female is discussed, in itself and in relation to and in comparison with surgical procedures. Technics of various workers are described.

Case reports illustrating treatment of different types and stages of the disease

are given. The frequency of multiple foci is pointed out. The favorable results in a small group of 11 cases are related, with 6 patients clinically free of disease one to three years and 4 more showing local improvement, though considered unsuccessful for various reasons.

X-ray therapy is recommended in adequately diagnosed cases of pelvic tuberculosis. Grossly diseased tubes should be removed if possible and the pelvis then irradiated to affect residual tuberculous granulations. Disease of the endometrium with minimal or no lesions in the tubes offers a good chance of success with irradiation alone. In peritonitis, x-rays are most useful in the dry form; they are useless against ascites and marked breaking down of tissue, but may be employed after these conditions have been dealt with surgically. Irradiation seems particularly effective in localized recurrences following surgery.

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Giant-Cell Tumor of the Lower Femur

Case Report with Roentgen and Pathological Findings Before and After Curettage and Roentgen Therapy with Amputation for Sarcoma[1]

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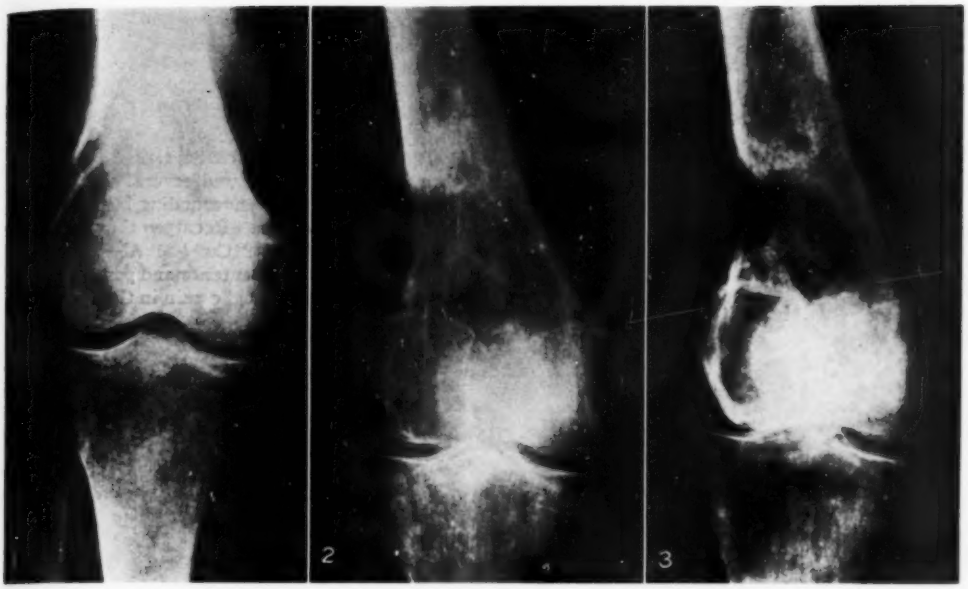
FOR 125 YEARS, from 1818 to 1943, low-grade neoplastic processes, now generally designated "giant-cell tumors of bone," have been mentioned in the medical literature. Cooper and Travers (20) seem to have described them well grossly, with some clinical and therapeutic aspects, in 1818. Lebert (45) is usually given credit for the first description of the giant cells of the medullary tumors in 1845. In 1854, Paget (56) referred to many cases of "myeloid tumor" and discussed in detail the gross, microscopic, clinical, and operative details. He believed these tumors were "not apt to recur after complete removal." In 1860, Nélaton (54) reported 46 cases in detail, and in 1879 Gross (32) followed with 70 cases of benign giant-cell sarcoma, 5 of which underwent malignant change. Virchow (69) in 1865 raised the question of malignant behavior of myeloid sarcomas. Although most of the cases appeared to be benign, excision or amputation was considered the safe therapeutic procedure for nearly one hundred years. Bloodgood (4) watched Halsted excise the lower forearm and carpal bones for a giant-cell sarcoma in 1893 and performed his own first curettage of the tibia in 1902. Coley (15) in the same year began x-ray therapy in conjunction with surgery and the use of toxins for bone sarcomas. Pfahler (58), in 1906, made roentgenograms and gave roentgen therapy alone to a giant-cell tumor of the upper fibula. Mallory (48), in 1911, and Bloodgood (5), in 1912, appear to be responsible for the change in nomenclature from "giant-cell sarcoma" to "giant-cell tumor."

Favorable mention of roentgen therapy for giant-cell tumor has been made by Pfahler (58), Coley (18), Bloodgood (6), Herendeen (34–36), Kolodony (44), Borak (7), Codman (11–13), Geschickter and Copeland (27–29), Brunschwig (8), Peirce (57), Evans and Leucutia (23), Ewing (24), Meyerding (51), Coley and Miller (14). The quantity and quality of radiation in the earlier years could not be accurately measured. Even in later years dosage has seldom been mentioned. When recorded, it has varied from a fraction of an erythema dose at intervals up to "eight treatments totaling 30,000 r (14,000 r laterally and 16,000 r medially)." This latter dose was given by Coley and Miller (14) to a tumor of the femur (factors: 250 kv., 1.5 mm. copper filtration, 50 cm. target-skin distance; lateral portal 8 × 12 cm., medial, 15 × 12 cm.) Successful dosage of tumors with adequate biopsy (not aspiration), followed for sufficiently long periods of time, has not been found in the medical literature. Sosman (63), Doub, Hartman and Mitchell (21), and Kleinberg (43) have had the courage to report poor results with roentgen therapy.

Curettage, instead of amputation or excision, was considered a possible method of treatment by the earlier surgeons, but it remained for Bloodgood (4–6) to advocate and popularize this type of therapy. Geschickter and Copeland (28, 29), his pupils, however, admit that primary curettement in 105 cases was followed in 31 by recurrence, with 16 cures on the second or third trial. Meyerding (51) appears to have used "excision by curettage" with success.

The age of our patient (50 years), the site in the lower femur, and the poor bony shell would be considered as contraindications to curettage by many surgeons.

[1] Accepted for publication in May 1943.



Figs. 1–3. Successive roentgenograms, Jan. 3, March 3, and Sept. 3, 1935. Figure 1, Jan. 3, 1935, led to a diagnosis of giant-cell tumor of the lower femur. Figure 2, March 3, was made about seven weeks following curettage and 1,000 r (measured in air) of medium-voltage roentgen therapy. Figure 3, Sept. 3, shows the remarkable improvement following 2,750 r (in air) of medium and deep roentgen therapy.

Hinds (37) and Bloodgood (5) both report cases at this site, successfully cured by curettement.

CASE REPORT

M. T. R., white married male aged 50 years, a farmer, was admitted to the hospital Jan. 3, 1935. His chief complaint was pain and swelling in the right knee, of two months' duration. Six months before admission his lower right thigh "gave way" while he was at work. Swelling began in the knee four months later and pain, aching in character, gradually increased in severity. The knee was slightly flexed and could not be fully extended, and the patient walked with the aid of crutches. No redness or heat had been noticed and there was no history of trauma. The past and family histories were irrelevant.

Physical examination was negative except for the right lower extremity. There were moderate swelling in the right knee and slight swelling in the right leg, ankle, and foot. The leg presented a bluish color with some pitting and edema of the ankle and foot. There was moderate tenderness over the entire knee joint, more pronounced over the outer side of the lower end of the femur. No sensory changes were observed. The dorsalis pedis pulse was felt, with no pulsation in the posterior tibial artery. The reflexes were normal.

The blood Wassermann test was negative. Urine examination was negative. The hemoglobin was 90 per cent, red blood cell count 4,120,000, white cell count 7,000 per cu. mm., with 84 per cent polymorphonuclears and 16 per cent lymphocytes. The blood sugar was 99, N.P.N. 34, calcium 12.7, phosphorus 3.6, chlorides 424 mg. per 100 c.c.

On Jan. 3, 1935, roentgen examination (Fig. 1) showed a large, rarefied, moderately trabeculated area in the lower right femur, measuring 7.5 cm. in length, 6 cm. in depth, and 9 cm. in width, apparently a large giant-cell tumor involving the medulla and cortex. The periosteum was not elevated. The cortex was not broken. There was slight decalcification of the bones of the knee, probably atrophy of disuse.

A film of the chest showed the lung fields to be clear and there was no evidence of any metastatic malignant process. Films of the skull and dorsal and lumbar spine, made on Jan. 5, showed no definite decalcification or miliary granular defects characteristic of hyperparathyroidism.

Operation by Doctor Griffin, Jan. 12, 1935, under ether anesthesia, disclosed a large cystic area in the external condyle of the femur, chiefly filled with friable material resembling granulation tissue but more yellow. Curettage of the cavity was performed, without note of any cauterization.

The gross pathological description was as follows: "Several pieces of tissue varying between 1 and 3

cm. in greatest dimension, comprising a bulk of approximately 15 c.c. They are irregular in shape, soft and friable in consistency; portions are red, other portions are pink, while much of the substance is yellowish-white and casecus in consistency."

Microscopic examination (Fig. 6) showed a granulation tissue-like matrix of fusiform, round, and polyhedral cells supporting numerous giant cells, constituting the essential structure of the tumor. There were, however, many areas of xanthomatous degeneration in which lipin-distended phagocytes predominated, without giant cells, and also areas of sparsely cellular fibrosis, without giant cells.

The *pathological diagnosis* was: "benign giant cell tumor; radiosensitivity doubtful and unreliable; reported results inconsistent" (Lewis C. Pusch).

Two weeks after operation, in a ten-day period, 1,000 r measured in air (tumor dose of 500 r) was delivered to the lower right femur, using 130 kv. with 4 mm. Al, through anterior and posterior portals. The patient was discharged on Feb. 6.

Additional x-ray therapy was administered once monthly in March, April, May, June, and September, in 1935, with the above factors, in doses of 250 to 500 r, totaling 2,750 r in air.

Roentgenograms made March 3, 1935 (Fig. 2) showed slight bone productive change with very slight improvement. On Sept. 3, 1935 (Fig. 3), six months later, bone production had increased along all borders.

Clinically, the patient fared well for two and a half years. Pain then reappeared and he was admitted to the hospital on Sept. 26, 1937. Roentgenograms (Fig. 4) showed several cystic areas in the lower femur with surrounding bone production with thickened cortex. Roentgen therapy—1,700 r in air, 200 kv. with 2 Cu + 1 Al—was given in divided doses through anterior and posterior portals.

Following treatment the pain in the knee was entirely relieved for about two months. Again an intermittent shooting pain confined to the inner side of the right lower femur appeared. Soft tissue swelling was found on physical examination.

Figs. 4 and 5. Roentgenograms made in 1937 and 1938. Figure 4, September 1937, shows beginning thinning and rarefaction of the inner cortex, two years and eight months following curettage and the roentgen therapy mentioned in the legend of Figure 3. Figure 5, March 3, 1938, shows destruction of the inner cortex with tumor breaking through the soft tissues, two months following 1,700 r (in air) additional deep therapy.

On March 3, 1938, roentgen examination (Fig. 5) of the right knee showed the same dense trabeculated bone throughout the lower 4 inches of the femur. The outer four-fifths appeared solid. Just above the inner condyle was an area, 1 inch in diameter, which showed rarefaction, suggesting bone destruction. An area of density extended outward in the soft tissue past the cortex. The diagnosis was still giant-cell tumor.

On March 5, 1938, with a long 17-gauge needlel an aspiration of the softened area on the media,

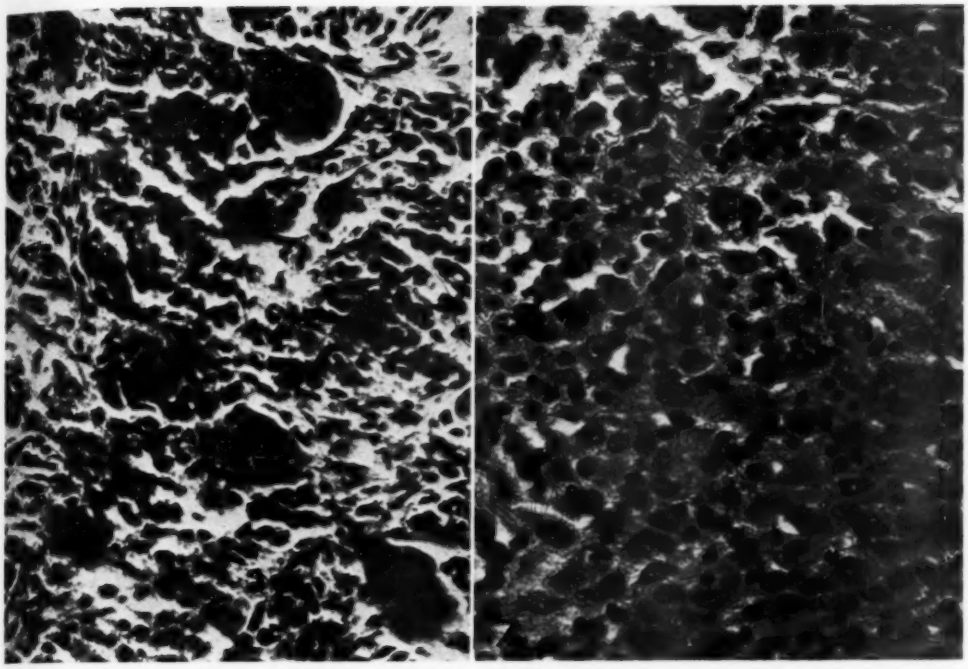


Fig. 6 Section (January 1935) showing typical structure of benign giant-cell tumor with uniform multinucleated giant cells, well differentiated. Fig. 7. Section (March 1938) of pleomorphic sarcoma showing large cells with hyperchromatic nuclei, prominent nucleoli, numerous mitotic figures, and atypical tumor giant cells. The tumor is infiltrated with small round cells resembling lymphocytes.

aspect of the lower end of the femur was done. In introducing the needle no resistance of the type produced by hard, firm, infiltrating tissue was encountered. The needle passed very easily, after traversing the subcutaneous tissue, into and through the mass and into the medullary spaces of the lower end of the femur. Occasional grating spicules of bone were encountered but the point of the needle did not come in contact with hard firm tissue which would be expected from a solid malignant growth.

The smear of aspirated material, stained with hematoxylin-eosin, showed the presence of small clumps of spindle-shaped cells of uniform size. They were not particularly hyperchromatic and appeared to be connective-tissue fibrocytes and osteoblasts. An occasional small osteoclastic giant cell was seen and small clumps of pseudoxanthomatous cells with granular abundant cytoplasm were found. No cytological characteristics indicating malignant change were observed. Other portions of cell clumps and tissue bits showed a loose connective-tissue type of stroma with abundant vessels.

The *pathological diagnosis* was: "benign giant-cell tumor of bone with abundant loose connective-tissue stroma and xanthomatous changes; no malignant changes found in aspirated material" (G. Z. Williams).

On March 14, 1938, curettement of the lower right femur was done under spinal anesthesia by Doctor Lippert and a cast was applied. The specimen included numerous soft gray and pink pieces of tissue, which, collected into a single mass, occupied a space approximately 3.5 × 2.5 cm. Some of the larger pieces were moderately firm and gristle-like in consistency, measuring 3 × 2 × 1 cm. A separate larger specimen, soft and yellowish in color, measured 4 × 3 × 1.5 cm. and contained a few small spicules of bone. There were two other similar pieces, 3 × 2 × 1 cm., and a small piece of irregular bony tissue, 2 × 1 × 1 cm.

Of numerous sections of the curetted tissue, only two showed dense connective tissue and one showed normal tendinous tissue. These were taken from portions which appeared to be the wall of the soft tumor, where the bone tumor encroached upon the soft tissues after breaking through the cortex. The remainder of the sections, from the inner portion of the cyst-like cavity of the bone, were composed of masses of necrotic cellular tissue which appeared to consist of necrotic tumor cells. Scattered in the peripheral zone and in small groups through this necrotic material were portions of well preserved tumor cells. These were characterized by extreme pleomorphic variation in size, shape, and nature

(Fig. 7). They were markedly hyperchromatic, the nuclei and nucleoli were large and varied in size and shape, most of them being spindle-shape. Mitotic figures were abnormal, bizarre, and numerous. The picture was definitely that of a highly malignant sarcoma. There were also patches of xanthomatous cells in loose stroma. The tumor was vascular. The necrotic areas were greatly predominant.

The *pathological diagnosis* was: "pleomorphic-cell sarcoma of the femur" (G. Z. Williams).

On March 18, 1938, under spinal anesthesia, a mid-thigh amputation of the right femur was done (Fig. 8), with tourniquet (by Doctor Oden). The stump was covered with equal skin flaps and the sciatic nerve was injected with alcohol. On March 31 the wound was healed and the patient was discharged the following day.

The patient was requested to return for examination at six-month intervals. He was living and well in March 1943, five years after amputation for sarcoma. Roentgenograms of the chest and physical examinations never disclosed any evidence of recurrence or metastases.

DISCUSSION

We realize that there are skeptics who will refuse to accept the evidence as presented in the reports and illustrations (Figs. 1 to 8), or even in the originals. They will refuse to be convinced unless the patient dies from ultimate metastasis. The microscopic diagnoses of benign giant-cell tumor and later pleomorphic sarcoma were reviewed by several competent and experienced pathologists with no differences of opinion. The sections were adequate and obtained from abundant curetted material in both instances. The patient has survived the amputation without recurrence or metastases more than five years. Roentgenograms demonstrated growth at the tumor site for six months preceding amputation. Roentgen therapy preceded a delayed amputation. Both of these procedures have been widely advocated in the treatment of bone sarcoma, and several patients are known to have survived.

Malignant change, with or without metastases, in cases originally considered to be giant-cell tumors, has been mentioned and discussed by Augé and Roux (2), Brunschwig (8), Chatterton and Flagstad (9), Codman (13), Coley and Miller (14), Coley (18, 19), Doub, Hartman and Mitchell (21), Dyke (22), Finch and Gleave (26), Goforth (30), Greenough, Simmons and Harmer (31), Gross (32), Jaffe, Lichtenstein and Portis (39), Kleinberg (43), Lewis (46), MacGuire and McWhorter (47), Morton and Duffy (52), Nélaton (54), Orr (55), Simmons (61), Stewart, Coley and Farrow (64), Stewart (65), Stone and Ewing (67), Turner and Waugh (68), Virchow (69), and others. In spite of the voluminous literature, a careful search will disclose very few case reports which can withstand the devastating critical analyses and rigid standards of the skeptics mentioned at the beginning of this discussion.

Geschickter and Copeland (28), following Bloodgood, have been the chief proponents of the benignancy of all giant-cell tumors. In 1930 they stated, in a review of 222 cases of giant-cell tumor, that "in no case has transformation of giant-cell tumor into sarcoma been proved." In 1936 (29) they modified this statement as follows: "The question is not whether a giant-cell tumor will metastasize—it never does—but whether these growths when they recur after improper treatment will undergo malignant change and give rise to osteogenic sarcoma. This question must now be answered in the affirmative." However, they stress the absence of reports in which metastatic nodules have shown the structure of typical giant-cell tumors. When osteogenic sarcoma of bone develops, they believe that "the unhealed area of bone and not the nature of the original lesion is the important factor."

This seems to us to be an evasion of the main point of the argument on a technicality, *i.e.*, that when sarcoma has developed the histologic picture is no longer that of giant-cell tumor. Even if this be granted, for lack of evidence to the contrary, it does not alter the fact that, under present methods of treatment, a definite percentage of giant-cell tumors (7 to 15 per cent) pursue a course which must be regarded as malignant. That the cell type and

histologic picture of the tumor may change markedly in this process does not seem too surprising. Unless it can be shown conclusively that proper treatment can eliminate this percentage of malignant changes, it seems only logical to regard this as part of the natural history of the tumor.

We will readily agree that the most satisfactory evidence of the malignancy of a tumor is microscopic proof of metastasis. On the other hand, it seems to be carrying skepticism too far to refuse to call a tumor malignant unless metastasis occurs in spite of treatment. If this were the standard for other tumors, the percentage of cures would drop to zero.

Jaffe, Lichtenstein and Portis (39) classify giant-cell tumors of bone into three grades of increasing invasiveness, according to the character of the stroma. In grade I, the stromal cells are uniform in appearance, abundant, and compact. In grade II, the stromal cells are not so compact and are often disposed in whorls; tumors of this order may recur and become malignant. Grade III tumors are frankly invasive and metastasize; the stroma is loosely arranged, there is much pleomorphism of cells and mitotic figures are numerous. There is much to commend such a classification.

Before the recognition of hyperparathyroidism as a clinical entity (38), cases of multiple giant-cell tumors of bone were reported and Alexander and Crawford (1) summarized the literature up to 1927. A study of these cases from the clinical, pathologic, radiologic, and chemical aspects reveals that they were nearly all cases of hyperparathyroidism. Jaffe (38) deplores the tendency to label as a giant-cell tumor any fibrous lesion or scar in bone which contains a few osteoclasts. According to him, "strictly defined, a solitary giant-cell tumor of bone is a true neoplasm which originates from mesenchymal connective tissue and in which the stromal cells and the giant cells show a close histogenic relationship. Furthermore, in such a tumor, one should be able to see evidence that the giant cells

Fig. 8. Gross specimen (March 1938) of the amputated femur following curettement, showing cyst-like defect in inner aspect of the femur.

are abundant, are a signficant part of the histologic picture, and do not resemble ordinary osteoclasts."

Therapeutically, there seems to be general agreement that the benign tumors are usually cured by thorough curettage or excision. Also it appears that amputation is agreed upon as the treatment of choice in the malignant tumors.

Where amputation is impossible, as in the spine or skull, and in surgically inaccessible benign tumors, roentgen irradiation is advocated by most of the conservative authors. Frankly, however, we cannot agree to such a broad therapeutic principle. We would advocate leaving alone a grade I benign giant-cell tumor inaccessible to curettage or excision rather than subject it to the as yet undetermined hazards of irradiation. In malignant tumors (grade II and grade III, Jaffe) inaccessible to excision or amputation, pro-

tracted roentgen irradiation with heavy dosage appears to be justified, as a last resort.

Concerning benign giant-cell tumors (grade I), there is no convincing evidence that roentgen therapy alone is curative. Nor is there evidence that "postoperative roentgen therapy is indicated routinely" (8). And we cannot agree that "roentgen therapy correctly administered does not increase the risk of complications" (8). In fact, no satisfactory evidence was found that radiation should be used at all in the treatment of benign giant-cell tumors.

SUMMARY

1. A case of giant-cell tumor of the lower femur is reported, with clinical, roentgen, and pathological findings before and after curettage, roentgen therapy, and amputation. Sarcoma was found three years after the first operation, and the patient is living and well five years following amputation.

2. Giant-cell tumor of bone has been recognized as a definite clinical and pathological entity for the past 125 years.

3. The sound teachings of Paget, Nélaton, and Gross, between 1854 and 1879, still hold good on many points.

4. No infallible "typical" roentgen-ray appearance of benign giant-cell tumor of bone is known.

5. The finding of giant-cell tumor by aspiration biopsy does not necessarily exclude sarcoma.

6. Adequate biopsy material and microscopic diagnosis of benign giant-cell tumor do not guarantee that malignant giant-cell tumor or sarcoma may not be found at the same site at a future date.

7. A survey of the literature suggests that recurrences are most frequent following curettage without cauterization or curettage plus roentgen therapy.

8. There appear to be fewer recurrences following complete excision with bone graft or amputation.

9. There is a great need for publication of the end-results of benign giant-cell tumors, adequately proved by good microscopic sections before roentgen therapy, and treated with roentgen rays alone. Until such reports are made, roentgen therapy cannot be properly evaluated or considered the treatment of choice for giant-cell tumor of the long bones.

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Tissue Changes Produced in C3H Mice by 50 r Whole Body Exposure[1]

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STRONG INTEREST is manifested today in the effects of small-dose irradiation on the animal body. This is because such exposures may be of common occurrence, and the cumulative action may bring about serious injury. Tissue and blood changes produced by larger doses of radiation have been adequately described (1, 4, 8). There appears to be general agreement on such points as the following: (1) The more sensitive tissues of the body are the lymph nodes and gonads; the bone marrow, intestinal mucosa, and skin being only slightly more resistant. (2) The blood picture is altered by radiation, and this alteration reflects in some manner the extent of tissue damage. (3) The degree of tissue injury varies with the dose of radiation applied. (4) Partial or complete recovery will occur in animals which survive the injury. (5) Histologically, high doses produce necrosis of cells with loss of functional elements and over-proliferation of fibrous connective tissue.

Thus far not much attention has been directed toward the study of changes produced by smaller doses of x-rays. It is not known, for example, what constitutes the threshold injurious dose for the more susceptible tissues, what are the earliest histologic changes, or how long such changes may persist. Furthermore, from a more practical point of view, it is not known whether the early tissue changes are reflected in the blood picture. It is our purpose to deal with some of the threshold modifications induced in tissues and blood by small doses of hard x-rays. Although threshold changes are difficult to detect histologically, we shall describe the modifications which appeared to be clearly an effect of x-rays, presenting these on a time basis.

A single small dose of x-rays may produce significant tissue changes, intermittent exposures being to some extent additive. Such changes may also result from treatments applied locally. In order to study these aspects, the first step is to investigate the effects of a small acute dose applied to the whole body.

METHODS AND MATERIALS

Since extensive morphologic studies are impractical in man, experimental approaches in animals were sought, and the mouse was decided upon. Young adult male C3H mice from an inbred colony (maintained by Dr. J. W. Thompson, National Cancer Institute) were used. From a series of preliminary experiments it was found that doses of 50 r produced faintly detectable tissue and blood change. Hence 50-r doses were used in the study reported herein. The treatment conditions were: 200 kv., 20 ma., 0.5 mm. copper, 1.06 mm. aluminum filter, 105.3 cm. distance, 8 r per minute (measured in air), exposure time 6.18 minutes.

Blood counts were made and tissues were fixed at the following times after irradiation: 1, 2, 4, 8, 12, and 24 hours, 2, 4, 7, 10 and 14 days. The blood studies consisted of total leukocyte and differential counts. Pre-experimental control counts were made on all animals. During the experiment three animals were examined each time a count was made and enough were used so that it was not necessary to repeat the examinations more often than once a week. Three animals were killed at each time interval for the tissues, which were fixed. Zenker-formol fixative and

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hematoxylin-eosin stains were used exclusively. For the most part the following tissues were examined: lymph nodes, sternum, spleen, thymus, testes, intestine, stomach, lung, kidney, liver, and skin.

RESULTS

Hematologic Picture: The blood changes observed are recorded in Figure 1. The abscissas show time in days and the ordinates the number of cells in each instance. The upper graph pertains to the total leukocyte count, the middle one to total lymphocytes, and the lower to total neutrophils. The average (arithmetic mean) leukocyte precount value was 11,550, the range being 7,850 to 15,820, and the average deviation from the mean ±1,640. The dotted line of the graph represents the level of the average precount value. Likewise, the average lymphocyte value was 6,800 ± 640 (range 3,460 to 11,100) and the average neutrophil value was 4,550 ± 470 (range 2,500 to 6,620). The levels for the average lymphocyte and neutrophil values are also shown by dotted lines in the respective graphs.

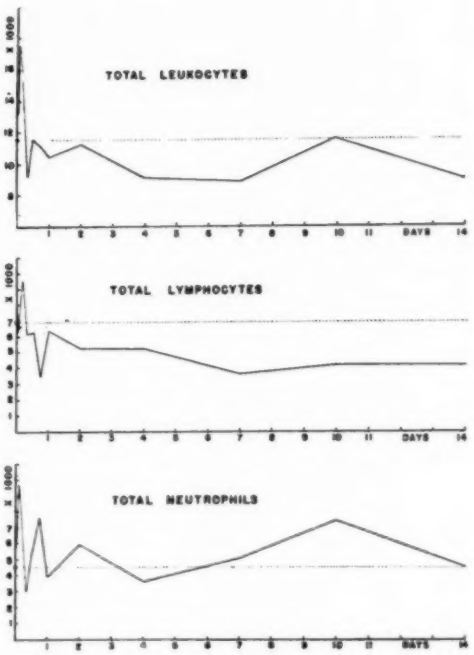

Fig. 1. Curves showing blood changes. The abscissas indicate time in days and the ordinates the number of cells in each instance.

There is evidence of an abrupt rise in all of the curves followed by a sharp fall. The leukocyte fall reaches the lowest level at about the fourth or fifth day, and there is an indication that a slight leukopenia is present during most of the period of observation. Lymphocyte and neutrophil curves show more precisely what happened. It will be seen that the leukopenia was mainly or exclusively lymphopenia and that the latter persisted throughout the course of the observations. Hence it becomes clear that while the small dose of 50 r, as used, will cause a fall in lymphoid elements of the mouse's blood, the myeloid cells are little affected. Moreover, it is evident that a period of more than two weeks is required for recovery from the comparatively mild lymphopenia.

General Histologic Changes: There was a brief generalized two-hour vasodilatation. The earliest discernible tissue change was an eosinophilia and cloudy swelling of the cytoplasm with poor staining of the nuclei. Upon further study, it was found that by staining fresh sections with varying intensity the relative cellular eosinophilic shift was always constant and that it occurred in all tissues. It was seen in the tissues fixed at one hour and its persistence ran a varying course depending upon the type of tissue, being lost at eight hours in spinal cord and ganglia and lasting as long as twelve hours in intestinal mucosa and bone marrow. With the disappearance of the eosinophilia, the cytoplasmic swelling and hyperchromia of the nuclei shifted to the basic side, with final return to normal staining of all tissues at twenty-four to forty-eight hours. This whole change was considered to be a very mild form of parenchymatous degeneration which returned rapidly to normal.

Lymph Nodes and Spleen: The one-hour material showed considerable swelling of the primitive monocytes, the accumulation of which produced wedge-shaped sheets of cells about the periphery of the

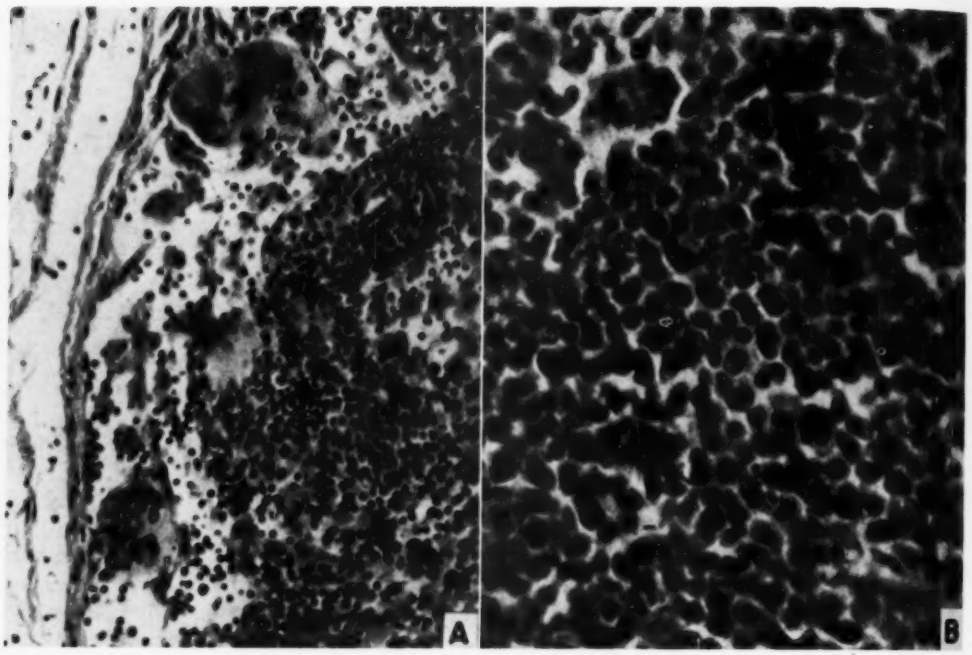

Fig. 2. A. Photomicrograph of the periphery of a mouse lymph node twenty-four hours after irradiation. Edema is marked; the monocytes are especially prominent, many of them lying free in sinusoids. Sinusoidal packing with lymphocytes is seen. Two multinucleated giant cells lie beneath the capsule. × *c.*115. Hematoxylin and eosin stain.

B. Higher-power magnification of a lymph node twelve hours following irradiation. Flecks of necrosis with polymorphonuclear leukocyte infiltration are seen. × *c.*275. Hematoxylin and eosin stain.

nodes. Many of these cells became detached and were set free in the sinusoids. As early as four hours after treatment multiple flecks of necrosis appeared in the germinal follicles, marked by small, tightly circumscribed groups of polymorphonuclear cells (Fig. 2B). Multinucleated giant cells occurred after four hours and as late as three days. Due to their rapid appearance and since transitional forms were seen, these were considered to be formed by fusion of monocytes (Fig. 2A) for the following reasons. Between eight and twelve hours the minute necrotic foci and the edema tended to disappear, giving way at the end of this time to an increased cellularity of the nodes. Some of the multinucleated cells present at this stage contained as many as forty nuclei. No clear mitotic wave was found, although the eight-hour and twelve-hour material suggested an excess of mitotic figures. The spleen showed changes similar to those in the lymph nodes, together with an increase in megakaryocytes. Pigment-containing monocytes were found in significant numbers in the spleen and lymph nodes at sixteen hours. Beyond this time no other histologic abnormalities were noted except the occasional multinucleated cells which persisted through the third day.

Bone Marrow: Changes in the bone marrow were less pronounced and lagged behind those in the lymph nodes. The earliest well defined modifications were found at eight hours. Instead of flecks of necrosis more cells of the adult myeloid series than normal were found. This suggested that minimal destruction had occurred unobserved at an earlier time. Megakaryocytes became abundant at twelve hours, and there was at this time a definite increase in myeloblasts. Some of the megakaryocytes showed bizarre nuclear configurations as late as seven

Fig. 3. Mucosa taken from the ileum one hour following irradiation. The edema is marked by the smoothness in outline of the villus and the general cloudiness of the cells. × *c.*165. Hematoxylin and eosin stain.

days. Increased vascularity, while prominent early, never became extensive in the late stages to the same degree as observed in other tissues. The increased alkalinity lasted as long as two to four days, and the megakaryocyte abnormalities considerably longer. Otherwise the tissue was histologically normal.

Ileum (lower portion): Edema was pronounced in the mucosa of the ileum due to the looseness of mucosal structure. Swelling occurred as early as two to four hours and was characterized by marked hydropic changes in the inner luminal cells of the villi, cells lining the deeper crypts being less affected. The cell swelling produced rounded protuberances on the villi (Fig. 3). The cells became vague in outline, and acid staining of the cytoplasm together with poor nuclear staining were seen. The swelling and abnormal staining lasted only a short time, with a return to normal within eight to twelve hours. No other significant changes were observed.

Testes: In the mouse testes under normal conditions there is marked variability in the mitotic activity from one seminiferous tubule to another (6). This may account for the variation in histologic pattern seen in different tubules. The following is as nearly a composite picture as could be gained. First, there was a general cell swelling as described for other tissues, with a proportional increase in the secondary spermatogenic cells at one to two weeks. During the period four to eight day, sgerminal cells in some of the tubules appeared ragged and pyknotic, and large irregularly shaped nuclei made their appearance (Fig. 4). Even at the most destructive phase the majority of the tubules showed normal spermatogenesis. By the end of three weeks the testes had returned to normal.

Other Tissues: No significant changes other than those already described were noted.

Control Tissues: None of the changes described above could be found upon examination of adequate control materials.

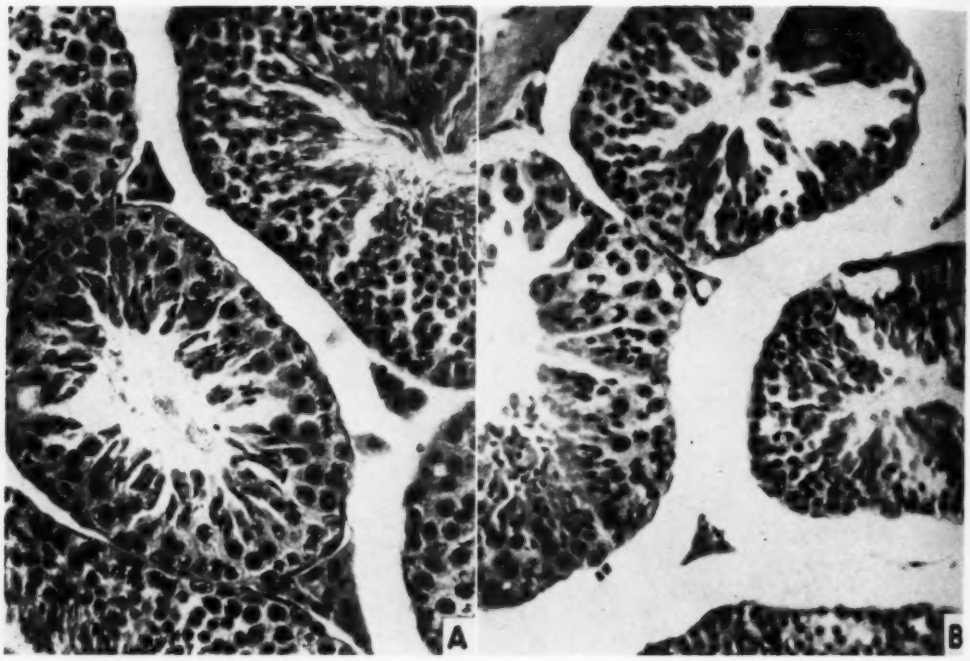

Fig. 4. A. Seminiferous tubule in cross section at twenty-four hours. There are irregularity in mitotic figure size and reduction in the number of mitoses, particularly among the group of secondary spermatocytes. × *c.*115. Hematoxylin and eosin stain.

B. Seminiferous tubule at one week. The "ragged" appearance of the tubules is here very striking, and the top tubule shows a considerable reduction in mitotic figures. × *c.*115. Hematoxylin and eosin stain.

DISCUSSION

By an early and systematic examination of the tissues of animals exposed to doses of 50 r (whole body exposure), slight but well defined and widespread changes were discovered. These changes lasted only a short time (from a few hours to several days), but they proved to be sufficiently consistent in occurrence to warrant the belief that they arose from the application of the x-rays. This belief is further warranted by the fact that any cell injury appears to bring about a lowering of *p*H with an increase of cytoplasmic acidity. Such a change is known to produce eosinophilia of the cell together with swelling and loss of clarity in cell outline similar to that seen in our material. Thus the cells in all tissues which we examined would seem to have suffered a mild form of damage, the majority surviving and quickly returning to normal.

In contrast with the view that a fairly long lag period may occur between the time of tissue breakdown and a shift in the peripheral blood picture (8), these experiments showed a close relationship between the occurrence of central tissue damage and an altered blood picture; flecks of necrosis occurred in the lymph nodes as early as eight hours, and the lymphopenia began at very nearly the same time. Although a brief leukocytosis was obtained, the response was irregular and quickly settled into a persisting leukopenia (prolonged lymphocytosis following repeated irradiation, has, however, been reported by Nakahara and Murphy, 7). The splenic changes were not so marked as those found in the nodes but followed the same general trend. The bone marrow changes were not so great as those in the lymph nodes and occurred at a later time. The occurrence of apparently greater radiore-

sistance of bone marrow, together with an excess in number of adult forms, is not unlike the findings obtained with higher dosages (4). It is of interest that, despite absence of histologic evidence of abnormality in the lymphoid tissues after one week, functionally there still existed a lymphopenia.

Although previous writers have spoken of early edema of intestinal mucosa following irradiation, their reports have referred to results obtained with larger dosages (200 to 400 r or more), and they have shown that the strongest modifications occurred at four days (2). With the small dose of 50 r used here, the effects (slight swelling and eosinophilia) were most pronounced at four to eight hours, the return to normal being rapid. This suggests that the duration of the injury varies with the dose, that is, with the amount of injury.

Certain sections of the seminiferous tubules showed moderate destructive changes. The variation in radiosensitivity of the spermatocytes, as well as the destruction of the basal cells, has previously been described (3, 9). The destructive changes, though never great, increased steadily over a period of twenty-four to forty-eight hours and required several days to disappear completely.

In conclusion, it is clear that distinct and definite histologic damage is produced by acute doses of 50 r applied to the whole body of the mouse. Furthermore, it is clear that, for the most part, the tissues showing the greatest sensitivity to large doses of radiation are the only ones histologically affected when small doses are used.

SUMMARY

1. Whole body exposure of C3H mice to 50 r of hard x-rays produced the following tissue changes:

(*a*) Swelling and eosinophilic staining of the cell cytoplasm with reduced nuclear staining; later slight hyperchromia of the cell and nucleus; final return to normal.

(*b*) Destruction of cells within the lymph node follicles, followed by a mild hyperplasia.

(*c*) Altered blood picture consisting of a momentary leukocytosis turning within eight to twelve hours into a mild but persisting lymphopenia.

(*d*) Reduction of mitotic rate and destruction of spermatogenic cells, with slow return to normal.

2. Since these changes represent only small deviations from the normal, they may be regarded as threshold irradiation effects.

3. The various effects appear at different times and last for varying periods.

4. Changes in the blood picture appear to follow closely the onset of damage to hemopoietic tissues but to persist beyond the period of hemopoietic tissue damage.

5. The evidence presented indicates that a lymphocyte count of the peripheral blood will give evidence of threshold tissue injury due to irradiation, whereas the leukocyte or neutrophil count would probably fail to reveal it.

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DISCUSSION

P. S. Henshaw, Ph.D. (Bethesda, Md.): I should like to make some comments concerning this paper. We have heard a good deal during the past two days, both in regard to protection and in regard to stimulation. After Doctor Pfahler's interesting paper[1] there were remarks pro and con regarding the idea that ionizing radiations may have a stimulating effect. There were objections to this view, and yet it seemed that there were several who were of the opinion that patients who had been given small doses of radiation showed an enhanced sense of well-being and that this constituted evidence for stimulation.

Here Doctor Nettleship has pointed out that definite cell injury may occur after doses of 50 r are applied to the whole body. I wish to raise the question whether stimulation may not result from just such damage. We are familiar with the stimulation for repair furnished by trauma. Is it not possible that x-rays, through slight destructive action, may furnish stimulus for improvement?

From the standpoint of protection, here is evidence of tissue injury produced by 50 r, a dosage which may be received accidentally by x-ray workers as well as others. Thus the old question is again raised as to whether the injurious effects of small doses of x-rays are additive. In our laboratory we have exposed mice to 5 r per day, applied five times a week. It was found that, whereas the animals remained vigorous and active, their life span was shortened. One is impressed then by the possibility that small amounts of injury, such as those described by Doctor Nettleship, may add up eventually to effects which are not stimulating but seriously injurious.

[1] Radiology **41:** 468–470, November 1943.

Determination of the Position of Calcium Deposits and Foreign Bodies from Stereoscopic Films Without the Use of a Viewing Stereoscope[1]

MAJOR SAM LEVI, M.C., A.U.S.

MANY PERSONS have a poor sense of stereoscopic perception. For these persons localization of the depth of a given shadow may be impossible by the usual method of viewing stereoscopic roentgenograms. In such cases fluoroscopic methods may help. In some locations, however, shadows are not easily studied fluoroscopically and in some instances they are not of sufficient density to be localized by this means. It would appear, therefore, that a method for determining depth by actual measurement on the stereoscopic roentgenograms would be of value to persons with poor stereoscopic perception. It would be of interest, also, to others who might wish to check the accuracy of their observations.

When we examine the well known basic principles of stereoscopy, we find that if the tube shift and the target-film distance are constant, the image shift bears a direct relationship to the object-film distance (Fig. 1). This relationship is expressed by the curves in Figure 3. The geometric equation for Figure 1 is derived as follows:

Where T_1T_2 = tube shift, T = target, O = object, S_1S_2 = shadow shift, F = film, since T_1OT_2 and S_2OS_1 are similar triangles,

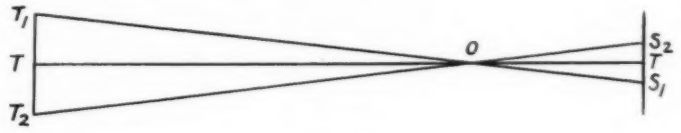

Fig. 1.

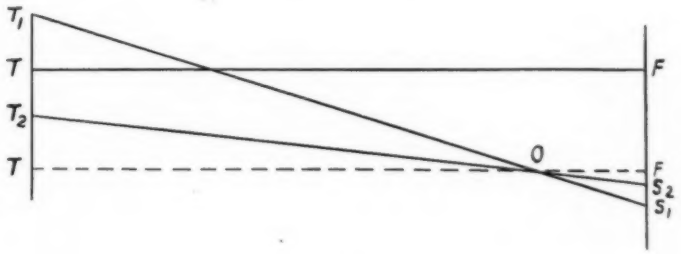

Fig. 2.

$$S_1S_2 : T_1T_2 :: OF : TO$$

$$S_1S_2 = \frac{T_1T_2 \times OF}{TO}$$

Substituting:

$$S_1S_2 = \frac{T_1T_2 \times OF}{TF - OF}, \quad \text{or}$$

$$\textit{shadow shift} = \frac{\textit{tube shift} \times \textit{object-film distance}}{\textit{target-film distance} - \textit{object-film distance}}$$

It should be noted that when the objects are not in the line of the central ray, the same formula will apply (Fig. 2).

[1] Accepted for publication in June 1943.

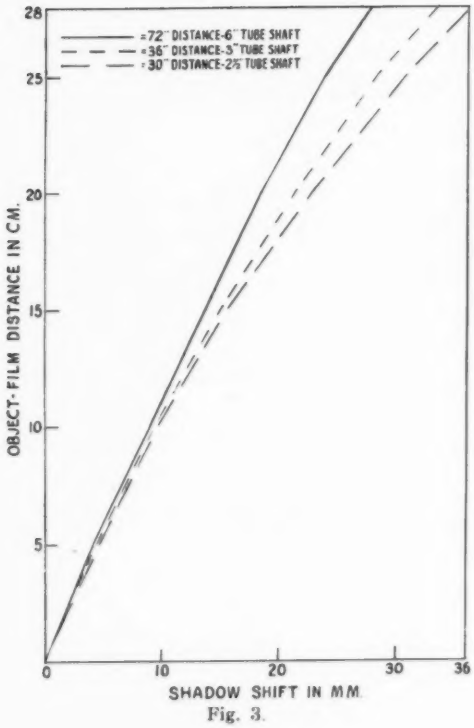

Fig. 3.

By utilizing a number of different object-film distances, the corresponding shadow shifts may be calculated. These, when plotted on co-ordinate paper, produce the curves shown in Figure 3.

Because all images move during stereoscopy, the actual shift of an object cannot be measured unless a known base line is drawn on the films. The distance from the top of the table can be measured, and a shadow known to be on the table, such as the number (or caption), will have a definite displacement for this measured distance, provided it is left undisturbed between exposures. By referring to the proper curve on Figure 3 the caption shift for that particular table top-film distance is obtained. A line is drawn perpendicular to the direction of the tube shift, from a chosen point on the caption to a point beyond the shadow. The distance between the shadow under study and this line is measured on each film. The lesser interval is subtracted from the greater. The relative shadow shift is thus determined. Then, by adding the caption shift to this (determined from Figure 3, because the caption-film distance is known), the absolute shadow displacement is determined. Referring back to Figure 3, the object-film distance is obtained. Subtracting the table-film distance, the distance of the shadow being studied from the table is determined. Since a given surface of the body has been placed on the table, the distance thus determined is the depth beneath that surface of the body at that point.

For example: given a table-film distance of 5 cm., a target-film distance of 36 inches, and a tube shift of 3 inches, it is desired to learn the depth of a bit of calcium in a pair of stereoscopic roentgenograms (Figs. 4 and 5). From Figure 3 a table-film distance of 5 cm. yields a shift of the caption of 4.3 mm. This is the caption shift.

Drawing a line (a) perpendicular to the caption, we obtain the apparent shadow shift by subtracting the lesser from the greater value ($4.5 - 4 = 0.5$ cm. or 5 mm.). By adding the shift due to table-film distance (caption shift determined above), the absolute shadow shift is determined ($4.3 + 5 = 9.3$ mm.). Referring to the chart we learn that a shift of 9.3 mm. represents a depth of 10 cm. By subtracting the table-film distance of 5 cm., the object being studied is thus shown to be 5 cm. from the surface of the skull touching the table.

If the object is dense enough to be seen when the films are superimposed, the method can be simplified by superimposing the captions and then measuring the distance between the shadows on the two films directly. Then, by referring to the curve and adding the table-film factor (in this example 4.3 mm.), the object-film distance can be immediately determined. It must be remembered that this is only true *if the caption was placed on the table and not moved between exposures.* In a general way, if extreme accuracy is not needed, the actual depth of the object

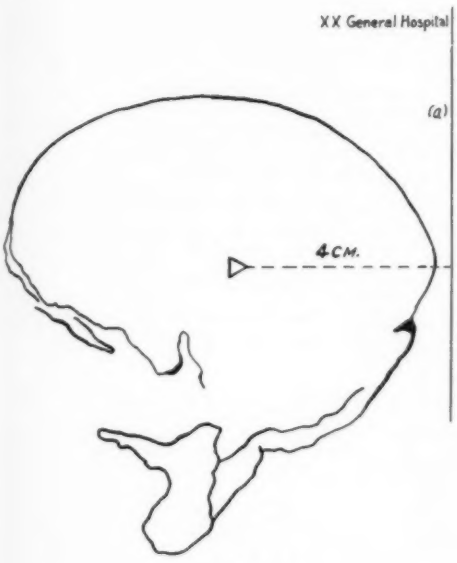

Fig. 4.

on the caption-superimposed films is one centimeter for every millimeter of shift. If we desire to learn the distance of the calcium from the midline, we can superimpose the sella turcica shadows on the lateral projections and measure the image shift. The answer in millimeters equals the number of centimeters from the midsagittal plane.

By measuring the relative shift of any two shadows on the films, we can determine the relationship of the objects they represent. The magnitude of error will be determined entirely by the care with which the measurements of small displacements are made and the accuracy with which the perpendiculars are drawn.

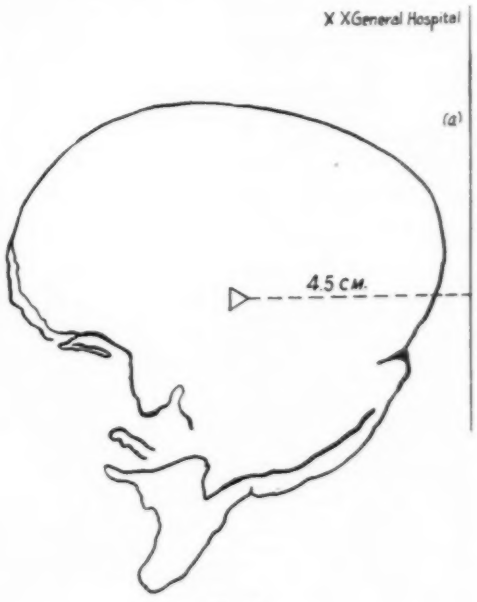

Fig. 5.

SUMMARY

A method for measuring depth from stereoscopic films is presented which requires only a common centimeter ruler. It should be of service to anyone who wishes to check the accuracy of his stereoscopic perception, and to all who have poor stereoscopic vision.

CASE REPORTS

Traumatic Serous Cyst of the Lesser Omentum[1]

MILTON BIRNKRANT, M.D.

Assistant Surgeon (R), U. S. Public Health Service

Primary cysts of the omentum are notably infrequent. Horgan (1), in a review of the literature up to 1935, found but 97 acceptable cases. Echinococcus cysts are most frequent. Dermoid, lymphogenous, serous, malignant, and traumatic blood cysts are also reported. Berger and Rothenberg (2) found but three omental cysts in the records of the Jewish Hospital of Brooklyn, a 660-bed general hospital, in a period covering twenty-three years.

The etiology of serous and hematogenous omental cysts is obscure, though there are many theories (Guernsey, 3). Occasionally a hematogenous omental cyst is preceded by trauma, but this is the exception rather than the rule. Serous omental cysts have been variously interpreted as congenital, lymphogenous, and inflammatory in origin.

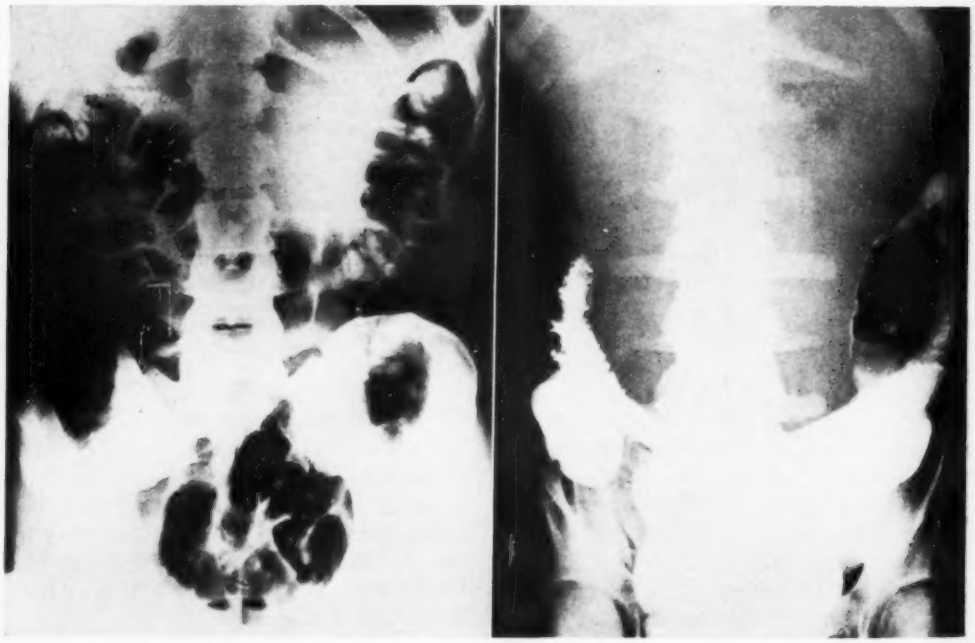

Fig. 1. January 1939, five days after injury. The colon is filled with gas and the transverse arm is at the level of the third lumbar vertebra, a normal finding.

Fig. 2. January 1939, twenty-two days after injury. The barium clysma shows a depressed transverse colon, with diffuse opacity above, produced by an extrinsic mass.

In view of our experience, the case reported by Gooding (4) in 1887 is of special interest. He described a serous cyst of the greater omentum "whose origin was obscure but which might have been due to a severe blow sustained some months before." On the assumption that Gooding's case was a traumatic serous omental cyst, the one here reported is the second in the literature.

[1] From the Private Service of Dr. Phillip Miller and the Radiological Service of Dr. Milton G. Wasch, Jewish Hospital, Brooklyn, N. Y. Accepted for publication in June 1943.

M. O., a 23-year-old white male, a carpenter, was admitted to the hospital in January 1939. Thirty-six hours previously, while working on a scaffold which gave way, he and his associate fell a distance of 4 feet, striking a pile of bricks. Simultaneously the elbow of the assistant struck the patient's abdomen with considerable force. He immediately experienced epigastric pain, soon followed by severe abdominal colic and persistent vomiting.

On physical examination the patient appeared dehydrated and in obvious pain. He had a temperature of 100° but pulse, respiration, and blood pressure were normal. Abdominal palpation revealed a questionable mass in the left upper quadrant with associated resistance and tenderness. Except for the abdominal findings, physical examination was negative. The white blood count ranged from 11,250 to 16,450, with from 76 to 85 per cent polymorphonuclear leukocytes. Several examinations of the urine were negative.

There was gradual abatement of the abdominal pain, and the vomiting, which had been persistent, slowly subsided. The condition then remained stationary until the eighteenth day, at which time there was an acute recurrence of abdominal pain and vomiting. The abdomen increased in size despite the fact that there had been a considerable loss of weight. The abdominal wall was tense and distended but not rigid.

A roentgenogram of the abdomen (Fig. 1), taken five days after injury, revealed a gas-distended colon with the midportion of the transverse colon overlying the third lumbar vertebra. A barium enema (Fig. 2) seventeen days later showed the transverse colon at the level of the lumbosacral articulation. It was concave upward and the haustral markings were lost. There was a diffuse homogeneous opacity in the upper abdomen. The findings were interpreted as indicating an extrinsic mass depressing the transverse colon.

A laparotomy was performed by Dr. Louis Berger two days following the enema study. On opening the peritoneal cavity several ounces of free sanguineous fluid were observed. The upper abdomen was entirely filled by a large round encapsulated mass, which compressed the stomach and displaced it forward. Thromboses in the smaller vessels of the gastric branches of the splenic and the left gastro-epiploic veins were present. The gastrocolic omentum was thickened, hemorrhagic, and infarcted. It formed the anterior wall of the tumor, which was identified as a cyst of the lesser omental sac. A needle was introduced and 5,000 c.c. of straw-colored fluid were withdrawn. The cyst collapsed and the walls were marsupialized.

Microscopic examination of the contents of the cyst was negative for chylous fluid. The total lipid content of the fluid was 764 mg. per 100 c.c.

A biopsy specimen from the greater omentum revealed extensive areas of extravasated blood and many markedly engorged blood vessels. Throughout the tissue there was an infiltration by small round and large mononuclear cells. Some eosinophils and polymorphonuclear leukocytes were also observed. The conclusion of the pathologist was that the omentum showed a chronic inflammatory reaction with a degree of acute activity.

Fig. 3. May 1943. Barium enema now reveals a normal transverse colon. The transverse arm is no longer depressed, and the haze overlying the upper abdomen is not present.

The patient made an uneventful recovery and has been observed over a period of four and one-half years. Roentgen examination in 1943 revealed the transverse colon in normal position with return of the haustral markings (Fig. 3). The opacity in the upper abdomen formerly noted had entirely disappeared. There were no symptoms related to the former illness and the physical examination was negative.

COMMENT

The importance of roentgenographic studies of the gastro-intestinal tract as an aid in the diagnosis of omental cyst has been previously emphasized by Lahey and Eckerson (5) and Krupp (6).

The history, radiological, operative, and pathological findings in this case indicate a traumatic serous cyst of the lesser omentum. One may speculate on the possibility of a pre-existing small simple serous cyst,

but this would be merely conjecture and the traumatic element would still be of primary importance.

U. S. Public Health Service
Bethesda 14, Maryland

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Fig. 1. Roentgenogram of mandible, showing extent of bone destruction by tumor.

Multiple Myeloma First Discovered in the Mandible[1]

ERNEST WOLFF, M.D., and LEWIS E. NOLAN, M.D.
Montgomery, West Va.

The observation and study of a case of multiple myeloma first discovered in the mandible, and apparently arising in that bone, inspired a thorough search of the literature, which failed to disclose a similar case. Myeloma is a rare tumor arising from the blood-forming cells of the bone marrow and at the time of first discovery is nearly always present in more than one bone.

According to Magnus-Levy (1), the order of frequency in which the bones are involved are ribs, vertebrae, sternum, calvarium, upper portions of the femurs, clavicles, upper ends of the humeri, lower ends of the femurs, innominate bones, base of the skull, and bones distal to the knees and elbows. Cutler, Buschke, and Cantril (2) collected a number of cases which they accept as examples of a single myeloma. They believe that the disease arises as a single focus and metastasizes. If one accepts their interpretation of myeloma as a true neoplasm, one must conclude that it differs from other tumors in the restriction of metastases principally to other bones. Bell (3) states that small myelomatous foci are occasionally found in the liver, spleen, and lymph nodes but regards these as extramedullary foci of growth and not as true metastases. Myeloma has not infrequently been found microscopically in bones which appeared normal roentgenologically; therefore, one should not necessarily draw the conclusion that the myeloma has its origin in a single focus merely because the roentgen-ray evidence is negative, at the time, in other bones.

A 44-year-old colored married female entered the Clinic in August 1941, complaining of pain and swelling in the left side of the lower jaw of eight weeks' duration. A tooth had become loosened over the area of swelling and she had pulled it with a string. Following extraction the swelling became gradually more pronounced and the lower jaw was more painful. She consulted her family physician, who incised the area and, obtaining nothing but blood, referred her to the Tumor Clinic of the Laird Memorial Hospital.

The patient had had the the usual childhood

[1] From the Departments of Radiology and Pathology of the Laird Memorial Hospital, Montgomery, West Va. Accepted for publication in June 1943.

diseases and in 1928 underwent hysterectomy for fibromyomata. She was well developed and well nourished, with no remarkable findings aside from the swelling and tumor formation, 4.0 × 5.0 cm., over the alveolar process of the lower left jaw. The pulse and respiratory rates were within normal limits and there was no fever.

Hematological survey disclosed erythrocytes 4,220,000; hemoglobin 13 gm. per 100 c.c. of blood; total leukocytes 6,500 (polymorphonuclear neutrophilic leukocytes 59, lymphocytes 38, monocytes 3, no immature or plasma cells). Attempts were made to demonstrate Bence-Jones protein, but the tests were all negative. The sedimentation rate by the method of Westergren was 55 mm. and 90 mm. for the first and second hours, respectively. Serum calcium, serum phosphate and serum phosphatase were within normal limits. Determination of plasma proteins gave no evidence of hyperproteinemia. The Kline test on the blood was strongly positive (four plus).

X-ray examination of the jaw disclosed a large, sharply defined, circumscribed area of decreased density, involving the greater part of the body of the left mandible, extending from the symphysis to the angle, with only a thin shell of bone remaining at the margin of the tumor (Fig. 1). There was no evidence of new bone formation. X-ray studies of the long bones, ribs, sternum, pelvis, and vertebrae showed no evidence of similar lesions. Roentgenograms of the skull revealed minute, punched-out areas in both parietal bones, the largest of these measuring 3.0 mm. in diameter. The x-ray interpretation was multiple myeloma involving the left side of the mandible and cranium.

The case was the subject of a conference in the Tumor Clinic and a biopsy study was recommended. Tissue was obtained from the area of involvement through the bed of the previously extracted tooth in the left molar region. Macroscopically the material was gray-red and rather soft. Microscopic examination of sections disclosed tissue made up largely of plasma-type cells with a loose cord-like and alveolar arrangement, with thin separating strands of fibrous connective tissue. There were occasional remnants of bone but no evidence of new bone formation. The tissue contained scattered small blood spaces lined with endothelial cells. The plasma-type cells were polygonal and rounded, showing fairly abundant deep pink cytoplasm with hematoxylin and eosin stain. The nuclei were rather large, rounded or oval, and eccentric in position within the cells. The chromatin was deeply hyperchromatic and arranged in blocks forming a cartwheel pattern, radiating toward the center. Very occasional mitotic figures were observed (Fig. 2). Diagnosis: Myeloma, plasma-cell type.

After the diagnosis was established, deep x-ray therapy with 200 kv., 50 cm. distance, filtration of 0.5 mm. copper and 1.0 mm. aluminum, was instituted, 200 r being given daily, alternately through

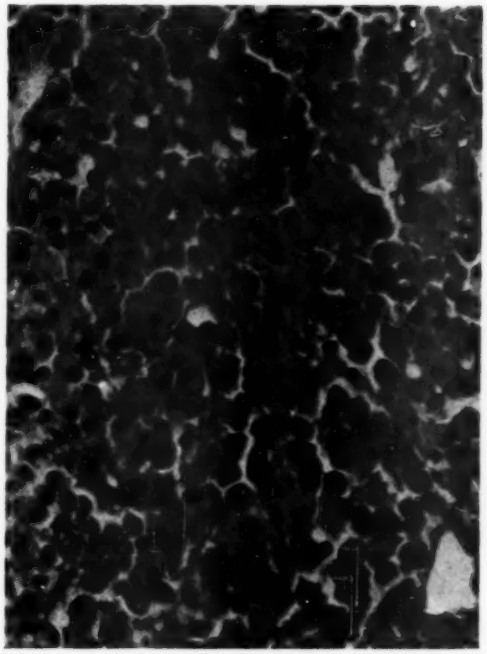

Fig. 2. Biopsy specimen of tumor in mandible, showing plasma-type cells. × *c.* 500.

two portals, 10 × 10 cm., for a period of fourteen days, for a total dosage of 2,200 r. The pain and swelling gradually subsided after 1,500 r had been administered. At the completion of the first series of treatment the face appeared normal and there was no swelling, pain, or tenderness in the mandible. The patient had no complaints. Roentgenograms of the mandible showed no reformation of bone.

The patient was seen at regular intervals and there was no recurrence of the lesion for eighteen months. Roentgenograms taken meantime showed no change in the area of decreased density in the mandible, but films of the skull revealed a gradual increase in size of the punched-out areas of rarefaction previously observed in both parietal bones, with numerous new such areas occurring throughout the cranial vault (Fig. 3). Roentgenograms of all other bones of the body were negative. Frequently repeated tests for Bence-Jones protein were also negative. Hematological surveys disclosed no changes in the blood picture. The patient has gained thirty pounds in weight, has a sense of well being, and is without complaints.

This case has been reported for two reasons: The first is that, to our knowledge, it is the first recorded example of multiple myeloma originating in the man-

dible, which must now be considered in the differential diagnosis of cystic tumors of the jaw. The second is to emphasize the fact that physicians as well as dentists should take biopsies of every non-inflammatory lesion of the gums, alveolar processes, and jaw bones. Because this type of tumor is relatively sensitive to radiation, great local benefit can be obtained, and we believe the life of the patient can be prolonged to an appreciable extent by means of properly administered courses of deep x-ray therapy to the involved areas.

Fig. 3. Lateral roentgenogram of skull, taken sixteen months after x-ray treatment. The bony defect of the mandible has not been filled in. Multiple punched-out areas in the skull are shown.

CONCLUSIONS

1. A case of multiple myeloma is described, with discovery of the characteristic lesion in the left side of the mandible, with minute, punched-out areas in the parietal bones.

2. Biopsy examination of the mandible disclosed myeloma of plasma-cell type.

3. The lesion in the mandible was controlled with deep x-ray therapy, with subsidence of swelling and complete relief of pain and tenderness.

4. The patient is living and in good health with no subjective complaints two years after the lesion was first manifest.[3]

5. The importance of biopsy examination is stressed in the diagnosis of non-inflammatory lesions of the mouth and jaws.

Laird Memorial Hospital
Montgomery, West Va.

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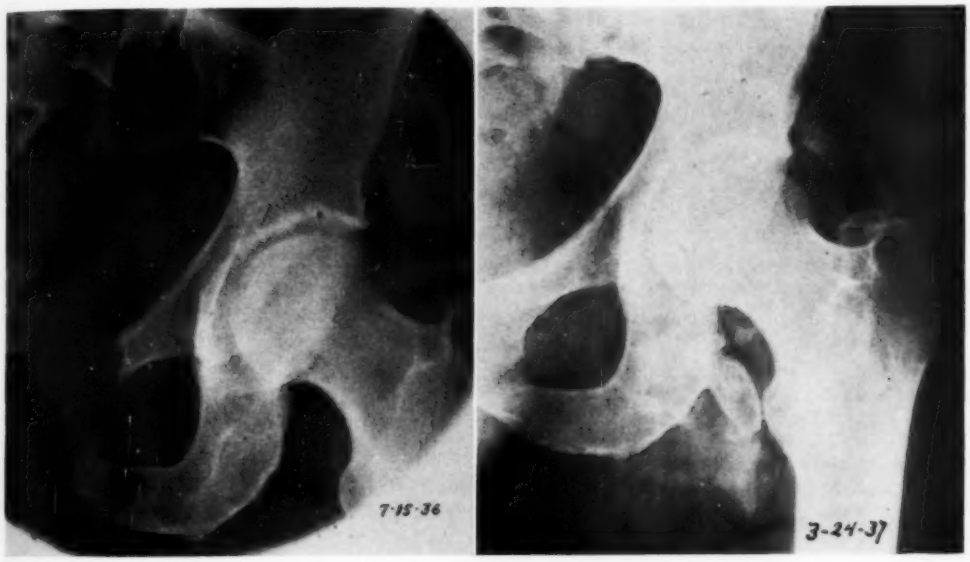
[3] After this report was in type, the patient was readmitted (November 1943), with metastases throughout the skeleton.

Tabetic Arthropathy of the Hip[1]

CAPT. IRVING WOLIN, M.C., A.U.S.
Station Hospital, Camp Beale, Calif.

The following report of a Charcot hip is submitted because the roentgenograms afford an opportunity of observing the progress of the disease from a very early stage up to the phase of complete disorganization of the joint. While this condition has been described frequently in the literature, very few roentgenograms have been presented showing the disease before extensive destruction has occurred. Ferguson (1) shows a film of a very early Charcot knee revealing some detritus in the joint and slight bony condensation. In the case described below no roentgenologically demonstrable destructive changes in the bone were present at the initial observation.



Figs. 1 and 2. Fig. 1 (left) shows the hip after reduction following the patient's first admission. Fig. 2 (right) shows extensive ossification of the joint capsule, eight months later.

G. B., a white female 57 years old, was admitted to Michael Reese Hospital, Chicago, on July 13, 1936. She stated that four weeks previously she had suddenly suffered a dizzy spell and had fallen, bruising her left thigh. Since this injury she had been unable to sustain her weight on the left leg, because of instability. The limb was painless. She had had tabes dorsalis for twenty-six years, with ataxia and frequent attacks of lightning pains in the extremities. There had been one miscarriage. Otherwise the history was not significant.

Examination revealed an inversion deformity of the left lower extremity with $1^1/_2$ inches of shortening. The greater trochanter was above Nélaton's line External rotation and abduction of the left hip could not be performed because of a bony block, but muscle spasm, pain, and tenderness were absent despite marked swelling and ecchymosis in the left groin. The telescoping phenomenon was easily elicited.

The pupils were unequal in size and non-reactive to light. The knee and ankle reflexes were absent. Position sense was absent in the toes. The upper extremities showed no motor or sensory disturbances.

The general examination was negative except for moderate emaciation.

The blood Wassermann reaction was negative, but the Kahn reaction was 3 plus. Roentgenograms made on the date of admission revealed a dislocation of the left hip, but there was no apparent involvement of the articular surfaces.

The following day reduction was easily accomplished, without anesthesia, by gentle traction on the flexed hip, followed by abduction and external rota-

[1] Accepted for publication in July 1943.

Fig. 3. Roentgenogram made Aug. 31, 1937, showing complete disruption of the architecture of the femoral head and a portion of the neck.

tion. Figure 1 shows the hip reduced, the radiological picture being that of a normal joint.

A spica cast was applied. Six weeks later the cast was bivalved and the patient went home, Aug. 23, 1936, wearing a posterior shell. She returned to the hospital six days later, stating that she had got out of her cast and tried to walk, and her hip had again "slipped out of place." General anesthesia with ethylene and ether was required for reduction of this recurrent dislocation. A cast was again applied and was worn for three weeks; it was replaced by a brace which prevented hip rotation but allowed flexion and extension. The brace was worn for six months. On March 24, 1937, the roentgenogram (Fig. 2) revealed normal position of the femoral head, with good articular space, but extensive ossification of the joint capsule. The patient then declined to wear her brace any longer. She was not seen again till Aug. 30, 1937, when she stated that four days previously her hip had spontaneously "slipped out" again. She had an eversion deformity with $1^1/_2$ inches of shortening, and roentgenographic examination (Fig. 3) made at Michael Reese Hospital was reported as follows: "There is complete disruption of the architecture of the femoral head and a portion of the neck. A small fragment of head still remains present in the acetabular fossa. Scattered about it, and far above and below the joint, there are numerous fragments of newly formed bone which are distributed irregularly above and below the sharply demarcated base of the old femoral head. The proximal end of the femur at this sharply demarcated edge is dislocated superiorly and makes no contact with the acetabular fossa. The findings are those of a Charcot hip."

The patient refused further treatment.

COMMENT

The serial roentgenograms show the progress of this case of tabetic arthropathy. This is the only case as far as the writer can determine in which films are presented showing a Charcot joint in so early a stage. Whitman's (2) statement that the disease is sometimes caused directly by injury but that the predisposing cause is the loss of protection due to the hypotonicity of the muscles is apparently well verified in this instance.

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EDITORIAL

Howard P. Doub, M.D., Editor

John D. Camp, M.D., Associate Editor

Eldwin Roy Witwer, M.D.

It is a trite saying that the honor should seek the man, not the man the honor. In the elevation of Dr. Eldwin Roy Witwer to the presidency of the Radiological Society of North America there can be no doubt that the man was chosen for the honor. Inasmuch as this office carries with it not only honor but responsibility and hard work, the selection of Doctor Witwer is especially fortunate, as he is singularly well equipped for the position by training and natural endowments. The executives of the Society who have worked with him in committee know of his genius for organization and management, as well as his untiring zeal. They have seen the excellent scientific exhibits produced during his five years as chairman of the committee having that matter in charge. A proper appreciation of his accomplishments, however, can be had only by those who have seen him in his daily activities during years of association.

Doctor Witwer has become an important fixture in the Detroit Roentgen Ray and Radium Society. A past president, he has been re-elected secretary-treasurer for fifteen years. This annual draft is a tribute to his ability and willingness to serve with no thought but the need of doing the job. He has been an important cog in the affairs of local and state medical organizations and is at present secretary of the Wayne County Medical Society and a counsellor of the Michigan State Medical Society. Among his numerous duties has been service on legislative and hospitalization committees and as liaison agent between lay and military organizations. Of exceptional merit is his work as chairman of the Wayne County Medical Society program committee, which has produced excellent programs with outstanding speakers.

Eldwin Roy Witwer was born in Huron County, Ontario, Aug. 23, 1890. His family early moved to Michigan, where he was educated in the public schools. For premedical training he attended Valparaiso University, and in 1914 received the degree of Doctor of Medicine from the Detroit College of Medicine and Surgery, now Wayne University.

After his graduation, Doctor Witwer went to Harper Hospital in Detroit, spending several years in the pathology laboratory of Dr. Plinn F. Morse. In 1920, after a course of special study in Cook County Hospital, he entered upon his radiological career as roentgenologist to the Charles Godwin Jennings Hospital in Detroit. In 1927 he became associated with the firm of Dr. Wm. A. Evans and Dr. Lawrence Reynolds in the practice of radiology, and now occupies the positions of radiologist at Harper Hospital, attending radiologist at Cottage Hospital and Marine Hospital, and consulting radiologist to Charles Godwin Jennings Hospital and Children's Free Hospital.

Doctor Witwer has contributed numerous articles to the literature of radiology and has made frequent presentations and participated in many discussions at society meetings. Though his professional activities have been unusually great, he has found time for furtherance of fellowship and has gone through the chairs of the Blue Lodge of Masonry and attained his 32nd degree.

ELDWIN R. WITWER, M.D.
President of the Radiological Society of North America

His chief hobby is farming, in which he shows a proficiency comparable to his medical skill. His registered Percherons are his pride and joy, and he combines the instinct of the traditional pioneer farmer with the latest ideas in modernization. Outings at the Witwer farm and the hospitality of the Doctor and his charming wife are memorable to many Detroiters.

The Radiological Society of North America could not have made a more happy choice of leader during this trying war year. Doctor Witwer's many friends join in wishing him all possible success.

E. WALTER HALL, M.D.

The Cumulative Index

The progress of scientific medicine in North America has been called one of the phenomena of this as well as the last century. Today the world recognizes this progress in many ways, by increasing references to American medical publications, by increasing numbers of exchange professorships and scholarships, and above all by an increasing regard for American medical research. The Director of the Medical Department of the British Council, Dr. N. H. Jones, recently wrote of "the considerable respect that many of us here have, not only for American medical literature, but for the remarkable lead that America has given to the rest of the world in everything pertaining to medical bibliography and medical librarianship."

It is therefore quite timely to notice the publication of our own Society's Cumulative Index, an index covering volumes 1 to 39 of RADIOLOGY, for the years 1923–1942.

The material covered by the Index embraces the entire field of x-ray and radium, through original articles as well as abstracts from a wide variety of journals, both foreign and domestic. A highly informative introduction is followed by almost 400 pages of text. Authors and subjects are listed in simple alphabetical order in a single index. Numerous subheadings and cross references are employed. References include original papers, case reports, abstracts, obituaries, book reviews, meetings and reports of the Radiological Society, Bulletins of the American College of Radiology, and miscellaneous items of scientific interest which have appeared in the pages of RADIOLOGY.

The actual style of the entries is in accord with that used by the *Quarterly Cumulative Index Medicus*, than which there is probably none better. The format is similar to that of RADIOLOGY, and the thickness equivalent to about two and one-half issues of the monthly journal.

In everyday work, in consultation practice and, above all, in preparing manuscripts, the value of a good cumulative index is beyond description. The Society is to be congratulated on completing the good work, and the Editor and his staff complimented on getting it out, despite the distractions of war and the difficulties of present-day publication. This "rich storehouse of radiological information" will soon be in every medical library and, probably, in most radiologists' offices. It is to be hoped that the demand will not exceed the supply available.

L. HENRY GARLAND, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

X-RAY EQUIPMENT
REVISION OF LIMITATION ORDER

Controls over the manufacture and distribution of x-ray equipment have been relaxed by the War Production Board through the issuance of General Limitation Order L-206 as amended. Former controls established by Order L-206, originally issued in October 1942 (see Radiology **39:** 738, December 1942), were necessary to break the bottleneck in filling military orders. In general, military orders are now being filled on schedule.

The amended order, effective Nov. 29, 1943, is a complete revision of the former order, designed to provide adequate equipment for civilian use without the paper work formerly required by special authorization of civilian purchase orders and by the filing of production and shipping schedules.

The chief provisions of the amended order are:

Shipments of medical x-ray equipment for civilian use are placed on a quota basis. Annual shipments of each manufacturer are limited to 75 per cent by dollar value of the average annual shipments made during 1937, 1938, and 1939. Quotas apply only to shipments within the United States, to its possessions and territories, and to Canada.

Medical x-ray equipment for the United States and Canadian military services and for export under Lend-Lease and OEW (now part of the Foreign Economic Administration) is not included in the quota. Industrial x-ray equipment is also outside the quota.

Former restrictions on models and types of specified x-ray equipment are removed from the order through deletion of Schedule A. Authorization applications (Form PD-556) need no longer be filed.

Coverage of the order remains unchanged. X-ray equipment, as defined, includes only power units; radiographic, fluoroscopic, and therapy tables; photofluorographic units; cassette changers; and tube stands. It does not cover parts, accessories, or appliances, or rebuilt and second-hand equipment.

DIRECTORY OF MEDICAL SPECIALISTS

Announcement is made that the *Directory of Medical Specialists* is now to be published by the A. N. Marquis Company of Chicago, publishers of *Who's Who in America*. Previous editions have been published for the Advisory Board for Medical Specialties by the Columbia University Press of New York City.

While the next edition will not be issued before 1945, on account of the war, a supplemental list of those who have been certified by the American Boards since the last (1942) edition of the Directory, totaling about 3,600, is to be published and distributed at cost. Monthly or bimonthly bulletins listing successful candidates for certification at examinations during the additional interim before the next edition are to be supplied as a subscribers' service.

Dr. Paul Titus (Pittsburgh) of the American Board of Obstetrics and Gynecology will continue as the Directing Editor, and Dr. J. Stewart Rodman (Philadelphia) of the American Board of Surgery continues as Associate Editor. The Editorial Board will be composed, as before, of the Secretaries of the fifteen American Boards.

Communications should be addressed to the Directing Editor, Directory of Medical Specialists, 919 N. Michigan Ave., Chicago 11, Ill.

AMERICAN ROENTGEN RAY SOCIETY

At the recent election of the American Roentgen Ray Society the following officers were chosen:

President: Sherwood Moore, M.D., St. Louis, Mo.
President-Elect: Lyell C. Kinney, M.D., San Diego, Calif.
First Vice-President: Paul C. Hodges, M.D., Chicago, Ill.
Second Vice-President: Aubrey O. Hampton, M.D., Boston, Mass.
Secretary: H. Dabney Kerr, M.D., Iowa City, Iowa
Treasurer: J. Bennett Edwards, M.D., Leonia, N. J.
Historian: Ramsey Spillman, M.D., New York, N. Y.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

SELECTED PAPERS FROM THE ROYAL CANCER HOSPITAL (FREE) AND THE CHESTER BEATTY RESEARCH INSTITUTE, Vol. 2, 1939–1940, London. Reprints of articles from various journals. 413 pages. Price 16/-post free.

MEDICAL RADIOGRAPHIC TECHNIC. Prepared by Members of The Technical Service Department of General Electric X-ray Corporation under the editorial supervision of GLENN W. FILES, Director. A volume of 364 pages, illustrated with 381 original figures. Published by Charles C Thomas, Springfield, Ill. Price $6.00 postpaid.

RADIOLOGICAL SOCIETY OF NORTH AMERICA

TWENTY-NINTH ANNUAL MEETING, CHICAGO
Dec. 1–Dec. 2, 1943

The Twenty-Ninth Annual Meeting of the Radiological Society of North America, held at the Drake Hotel, Chicago, Dec. 1 and 2, 1943, was limited to executive sessions, the scientific sessions, refresher courses, and exhibitions having been canceled at the request of the Office of Defense Transportation.

The meeting convened Wednesday morning, Dec. 1, 1943, when the official gavel was presented to Dr. Robert S. Stone, President, by Dr. Lewis G. Allen, Chairman of the Board of Directors. Doctor Stone responded and expressed the regret of the officers that the usual type of meeting had been canceled because of the patriotic desire to help alleviate the travel and hotel situation.

Doctor Stone then reported that prior to the cancellation of the scientific sessions he had arranged an excellent program and that the papers would be read by title. They thus became the property of the Society and would be published in RADIOLOGY, where all members would have the opportunity of reading them; the various essayists had been notified of this procedure and the papers were now due at the Editorial Office.

A quorum being present, an executive session was held and the usual business of the Society was transacted. Reports of the officers were presented and approved. These will subsequently be published and copies sent to the members. The following officers were nominated and unanimously elected:

President: Eldwin R. Witwer, M.D.
President-Elect: Lewis G. Allen, M.D.
1st Vice-President: Edgar P. McNamee, M.D.
2d Vice-President: Heddy S. Shoulders, M.D.
3d Vice-President: Zoe A. Johnston, M.D.
Secretary-Treasurer: Donald S. Childs, M.D.
Librarian: Howard P. Doub, M.D.
Member of Board of Directors: Davis Spangler, M.D.

In the evening the customary banquet was held and, while the attendance was small as compared to former years, the spirit of good fellowship was undiminished. Doctor Stone's presidential address was timely and interesting. It is hoped that it may be published later so that all may enjoy it. It was announced that honorary membership had been conferred on Dr. Charles G. Sutherland and that his Diploma had been sent to him. The newly elected officers were introduced and the Pfahler gavel was presented by Doctor Stone to the new president, Dr. Eldwin R. Witwer. In his response Doctor Witwer pledged that every effort would be made to arrange a meeting for next year unless the war situation is such that it is not feasible.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Sydney F. Thomas, M.D., San Francisco Hospital. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Haig H. Kasabach, Presbyterian Hospital, New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Contrast Media in Lesions of the Cerebral Hemisphere. Edgar A. Kahn. Proc. Roy. Soc. Med. **36:** 403–405, June 1943.

The author, a major in the Army of the United States, recommends thorotrast for the localization of cystic brain lesions and encapsulated brain abscesses. It is non-irritating in closed cavities, mixes readily with fluid contents, and is phagocytized by the cellular elements of the abscess wall, rendering it radiopaque. Since only a small quantity of the contrast medium is required and this is largely removed at the time of evacuation of the cavity, there can be no injurious radioactive effects. Short histories of 6 cases in which thorotrast was used are included: an otogenic abscess; abscess below a drained subdural abscess; deep-seated abscess; metastatic abscess from lung; cystic glioblastoma multiforme; cystic astrocytoma. In this last case a mural nodule was demonstrable.

As a means of preventing cortico-meningeal adhesions, the author suggests the instillation of air between the cerebral cortex and dura. He cites two cases in which this procedure was followed. It is his opinion that it will be useful in acute cranio-cerebral war injuries, following débridement with removal of potentially infected bone and damaged brain tissue, and his hope that it will reduce the morbidity of such injuries. HENRY K. TAYLOR, M.D.

THE CHEST

Value of Miniature Chest Films. Arthur S. Webb. Illinois M. J. **83:** 412–413, June 1943.

As a means of detecting possible chest lesions, the author has found stereofluoroscopic examination with 4 × 10-in. films almost 100 per cent accurate. His studies include over 4,000 films, of which 2,300 were 4 × 5 in., 1,000 4 × 10 in., and 850 14 × 17 in. Minimal lesions discovered on 14 × 17-in. films were re-examined on the 4 × 10-in. films and were invariably demonstrated, with adequate detail to dictate further study, on at least one of the stereoscopic pair.

The author is not a roentgenologist but a tuberculosis worker and as such is particularly interested in the cost of chest surveys. While the 4 × 10-in. films are twice as expensive as the 4 × 5-in., he believes the greater accuracy of the former warrants the extra cost. Re-examination is done on 14 × 17-in. film when there is a question of interpretation or when a diagnosis is to be made because of the discovery of a possible lesion. HENRY K. TAYLOR, M.D.

Critical and Casuistic Contribution on the Theme "Fluoroscopy in the Army." H. H. Weber. Schweiz. med. Wchnschr. **73:** 793–796, June 19, 1943.

This is a critical discussion of the disadvantages of mass fluoroscopy as a tuberculosis case-finding method, covering many phases of the subject, from inaccuracies and poor definition of the screen to the inadvisability of having several hundred recruits cough in the examiner's face while he looks for cavities. While it is a competent review, it contains little new material.

LEWIS G. JACOBS, M.D.

Results of Systematic Fluoroscopy of an Army Unit on Relief from Service. C. Frei. Schweiz. med. Wchnschr. **73:** 778–782, June 12, 1943.

This is an account of the fluoroscopic examination of men about to be discharged from army service. Abnormal findings were considered an indication for roentgenographic study, clinical investigation, and determination of sedimentation rates.

Of 6,369 dischargees, 6,283 were studied fluoroscopically. In 55, pathological findings were obtained:

Active pulmonary tuberculosis	20
Old, inactive pulmonary tuberculosis	6
Eosinophilic lung infiltrates	13
Other pulmonary infiltrates	8
Bronchopneumonia	1
Peribronchitis	3
Pulmonary silicosis	1
Pathological cardiac findings	3

While this demonstrates that breakdowns from tuberculosis are now fewer than before those infected were weeded out, periodic fluoroscopy of troops would seem advisable to eliminate new cases of tuberculosis as they develop. LEWIS G. JACOBS, M.D.

Considerations on One Thousand Chest X-Ray Examinations Performed on Men Applying for Employment. A. A. Bauer. Illinois M. J. **83:** 415–417, June 1943.

Six hundred pre-employment chest roentgenograms of men between 18 and 45, seeking employment in industries entailing exposure to silica dust, were analyzed and catalogued as follows:

1. Healthy chest: 522 cases. This group presented no evidence of silicosis or active pulmonary lesions. It included calcified hilum nodes and primary foci; healed residuals of previous inflammatory, surgical, or traumatic processes; slight to moderate cardiac enlargement, slight widening of the aorta, and slight prominence of the aortic knob. Clinical and physical findings were negative.
2. Minimal grade silicosis: 22 cases.
3. Moderately advanced silicosis: 1 case.
4. Far advanced silicosis: None.
5. Pulmonary tuberculosis: 15 cases (5 minimal; 9 moderately advanced; 1 far advanced).
6. Tuberculosis and silicosis: None.
7. Special findings, not included above: 40 cases (cardiac enlargement; bronchitis and bronchiectasis; pleural effusion; wide aortic arch; prominent aortic knob; calcification of aorta; pulmonary fibrosis without beading; coarctation of aorta; pneumothorax; dermoid cyst).

Many of the men were applying for industrial work for the first time, and the observations are believed to give a fair index of findings among a group without complaints referable to the chest. The high percentage of healthy chests is of interest.

HENRY K. TAYLOR, M.D.

Miliary Calcification of the Lung. Erving F. Geever. Am. J. Roentgenol. **49:** 777–782, June 1943.

Miliary calcification of the lung is rather frequently encountered in routine chest surveys and has been

generally considered to be the result of tuberculosis. Several authors, however, have raised the question of other etiologic factors, including Aspergillus and Ascaris. In none of the previous reports have pathological studies been made. In the present report two typical examples of this condition are described, in both of which complete autopsy examinations were performed, the patients having died of entirely unrelated diseases. Detailed reports of the pathological studies are given. It is the author's opinion that the diagnosis in each instance was a healed miliary tuberculosis of the primary type. This interpretation was made on the basis of the close resemblance of the lesion to healed Ghon tubercles and because of the extensive hilar lymph node involvement. The infection had occurred many years previously, probably in infancy or childhood, and had completely healed. Although the possibility exists that other agents may cause this type of miliary calcification, the importance of tuberculosis should not be minimized.

L. W. PAUL, M.D.

Loeffler's Syndrome. James H. Smith. South. M. J. **36:** 269–271, April 1943.

A case of migratory pulmonary infiltrations associated with esoinophilia is presented. Loeffler had observed 51 such cases by 1936 and emphasized the benign character of the entire course of the disease in contrast to the striking and sometimes alarming objective signs.

In the author's patient, a 55-year-old white woman, the chief findings were severe bronchitis and slight asthma. She was undernourished and was troubled by a persistent cough. At various intervals from June 1941 to April 1942 she was found to have a leukocytosis averaging about 16,000 and reaching 21,000, with an eosinophilia up to 70 per cent, averaging about 35 per cent. These abnormal values showed a rather steady return to normal. At intervals a low-grade afternoon temperature elevation was recorded, reaching about 100° F. Extensive skin tests were negative except for sensitivity to vaccines made from respiratory organisms. Serial chest roentgenograms showed massive exudative right pleuropulmonary involvement with rather rapid resolution, followed by the appearance of new lesions. Within six weeks there remained only moderate basal pleural thickening and in five months the chest was normal. Although asthmatic symptoms were minimal at the time of the massive pleuropneumonic process, the patient since has had severe asthmatic symptoms. An infected maxillary antrum did not respond to treatment. It is believed that this syndrome is probably a response to some allergin. Tuberculin, pollens, and respiratory organisms are suggested as inciting agents. MAX MASS, M.D.

Discussion on Atypical Pneumonia. John W. Brown *et al.* Proc. Roy. Soc. Med. **36:** 385–390, June 1943.

Captain Brown of the Medical Corps of the Army of the United States opened this discussion with a general review of the subject of atypical pneumonia, referring briefly to his observations in an Army hospital in England, where 102 of 143 cases of pneumonia were of the atypical variety.

Lieut. Colonel Gordon E. Hein, also of the Army of the United States, reported that during an eight-month period approximately 100 American soldiers in England had been treated in his hospital for atypical pneumonia. The cases differed in no essential way from cases observed in the United States, but it was not certain whether the disease process was the same in all or whether the etiological factor was identical. These cases differed both from the bacterial pneumonias and from the influenza of World War I, and they did not resemble the classical psittacosis.

Dr. Philip Ellman assumed that the designation "atypical pneumonia" referred to the non-stereotyped pneumonias, as opposed to the stereotyped form of lobar or bronchopneumonia, and his discussion, therefore, was not on the same subject.

Dr. H. Joules mentioned that, of 57 pneumonias seen in a three-month period at the Central Middlesex County Hospital, 12 were of the atypical variety.

HENRY K. TAYLOR, M.D.

Bagasse Disease of the Lung. W. A. Sodeman and Roscoe L. Pullen. New Orleans M. & S. J. **95:** 558–560, June 1943.

A 26-year-old white male who had been working in bagasse dust for twenty weeks complained of shortness of breath and cough. Roentgen examination showed "a miliary ground glass mottling throughout both lung fields, radiating from the hilar regions." Biopsy done during the sixth week of illness yielded pulmonary tissue in which were embedded several "spicules" of an irregular foreign material, similar microscopically to bagasse. Under the polarizing microscope these "spicules" were seen to rotate polarized light. Many smaller scattered pieces, with an average size of 2 × 8 microns were also found, especially where there was a fibroblastic reaction of the interstitial tissue of the lung.

The authors also describe the microscopic findings in the lung in a case of bagasse disease coming to autopsy. Fundamentally the same type of reaction was present.

The conclusion is reached that the particles of bagasse in the lungs are responsible for an organic pneumonoconiosis. HENRY K. TAYLOR, M.D.

Nontuberculous Empyema Thoracis in Children J. K. Berman. Surg., Gynec. & Obst. **76:** 183–188, February 1943.

A study of 184 cases of empyema thoracis before and since the use of the sulfonamides is reported. The author states that rib resection with open drainage is the method of choice in the treatment of empyema thoracis in children. Since the advent of the sulfonamide drugs, fluoroscopic examination is necessary to determine the proper time for this procedure. Formerly the proper time for drainage was based upon the consistency of the pus obtained by aspiration. However, the pus may be thick very early in the disease when sulfonamides have been used, and this change in consistency may precede localization.

The fluoroscope is important to determine (1) whether or not localization has occurred and (2) the position of the encapsulated and interlobar varieties of empyema. The method is based upon the fact that with localization comes fixation of the walls of the empyema cavity. In children empyemas are usually massive, so that fixation of the movable diaphragm and mediastinum are accurate guides. The mediastinum

does not change so much in adults. Even in localized cavities, however, the phenomenon of fixation of the surrounding lung can be demonstrated.

In the child with empyema a thoracentesis is done to determine the type of organism, partially to empty the cavity of pus, and also to inject air. First, the child is observed in the upright position. The fluid level is easily seen and before localization moves with respiration. It descends with the diaphragm on inspiration and ascends on expiration. After localization two phenomena have been observed: (*a*) no movement—seen in bilateral and sometimes unilateral empyema; (*b*) paradoxical movement—seen in unilateral empyema due to an exaggerated movement of the opposite leaf of the diaphragm.

It is impossible to observe the movement of the diaphragm with the patient in the flat or upright position, because pus obscures the contour of the diaphragm and on the right side the liver also adds its dense shadow, making such observation difficult. With the patient tilted in the head-down (Trendelenburg) position the diaphragm can be seen easily if a sufficient amount of air is present in the empyema cavity (small amounts of air seen in the costophrenic angle only are of no aid); 20 to 30 c.c. of pus or more are aspirated and an equal amount of air is injected. Fixation of the diaphragm implies localization.

A third maneuver is employed to observe the mediastinum. The patient is turned on the affected side and is observed in the anteroposterior (lateral decubitus) plane. The pus gravitates away from the mediastinum, permitting observation of its movements. If it is fixed, the cavity is completely localized and open drainage may be safely done.

The author adds some observations as to the effect of the sulfonamides on the course of the disease and the occurrence of complications.

Xanthomatosis—Hand-Schüller-Christian Type: Report of a Case with Pulmonary Fibrosis. James H. Currens and Walter C. Popp. Am. J. M. Sc. **205:** 780–785, June 1943.

The presence of map-like defects of the skull, exophthalmos, and signs of hypopituitarism are not necessary for the conclusive diagnosis of Hand-Schüller-Christian disease. Involvement may occur in any part of the reticulo-endothelial system, resulting in such clinical signs as lymphadenopathy, pulmonary fibrosis, hyperpyrexia, hepatomegaly and splenomegaly, involvement of the long bones, and icterus. The etiology remains obscure; it is thought to lie in a disturbance in the metabolism of cholesterol and cholesterol esters. Some pathologists, however, believe that the disease may be an infectious type of granuloma.

A 29-year-old woman had intermittent twinges of pain over the right parietal region, followed in six months by a palpable swelling at that site and the occurrence of dull aching pain in the left hip. A tender, soft, raised zone with discrete borders, about 6 cm. in diameter, was found in the right parietal region. Tenderness was elicited over the greater trochanter of the left femur; the motion of the left hip was limited because of pain. The laboratory studies, including those of cholesterol, cholesterol esters, fatty acids, and total lipoids, were normal.

Roentgenograms of the skull showed an irregular zone of bone destruction in the right parietal bone. A similar defect was seen in the neck of the left femur. Extensive bilateral fibrosis was demonstrated in the chest film. Biopsy of the skull showed Hand-Schüller-Christian disease. The fat content of the biopsy specimen was low. The cyst-like areas in the skull and femur accounted for the symptoms, but the pulmonary fibrosis was unusual. The low fat content of the tissue suggested that the process was old. Because of the possibility that the pulmonary lesions might be granulomatous, irradiation therapy was given to the left lung, through an anterior and posterior portal. One treatment was given to the skull, and one to an anterior and posterior portal over the neck of the femur, using x-rays of 130 kv. Two additional courses of therapy were given at monthly intervals.

There was marked improvement of the skull and femur and slight improvement in the irradiated lung five months later. BENJAMIN COPLEMAN, M.D.

Carcinoma of the Lung. A Review of 31 Proved Cases at the Philadelphia Naval Hospital. Ferdinand Fetter. Ann. Int. Med. **18:** 978–987, June 1943.

Thirty-one patients (veterans) with proved primary lung carcinoma were admitted to the Naval Hospital in Philadelphia from Jan. 1, 1941, to Oct. 1, 1942. Unfortunately, no symptoms or physical signs are pathognomonic of pulmonary cancer. Cough and sputum were present in all but one of the patients. In addition, chest pain, hemoptysis, loss of weight, and weakness were generally found.

In this series the most important finding on the x-ray film suggesting lung cancer was atelectasis distal to the tumor, with an accompanying shift of the mediastinum toward the affected side. This occurred in 65 per cent of the cases. A less common finding was the single circumscribed lesion usually peripheral and beyond the reach of the bronchoscope. This was present in 15 per cent of the series.

Numerous methods are available for establishing a diagnosis. The most valuable procedure is the bronchoscopic examination. Biopsies are taken if abnormal tissues are seen. Bronchoscopy was done in 25 of the author's 31 cases and positive bronchoscopic biopsies were obtained in 14 of these, or 45 per cent of the proved cases. The use of iodized oil is not so helpful as bronchoscopy. In a suspected case, however, it may show stenosis proximal to an area of atelectasis.

The presence of pleural fluid in lung cancer makes the case inoperable. If tumor cells are found in the pleural fluid, it signifies an extension of the tumor to the pleura. Aspiration biopsy of the lung is almost universally condemned as being too dangerous, due to the possibility of an air embolism.

In suspicious cases, if the patient is in reasonably good health with no evidence of metastasis, an exploratory thoracotomy should be done.

Those cases in which the diagnosis is established by a biopsy from a metastatic lesion are obviously inoperable.

Roentgen therapy should be used only as a palliative measure in inoperable cases to relieve such symptoms as pain and dyspnea. Surgical removal offers the only hope of cure. In the hands of experienced chest surgeons, the operative mortality has decreased from 33.3 to 16.6 per cent. Of the 31 patients in the author's series with a proved diagnosis, 6 were operated upon, but in none was surgical removal of the lesion possible. Roentgen therapy was employed in 16 inoperable cases, including 4 of those in which exploratory

thoracotomy had been done. In no case was a cure obtained, but in about half symptoms were relieved and the patient was more comfortable than before treatment.

The difficulty and delay in establishing a diagnosis plus the technical difficulties involved in the surgical removal of the involved lung make pulmonary carcinoma a highly fatal disease.

Several roentgenograms and a short bibliography are included. STEPHEN N. TAGER, M.D.

"Spring Water" Cyst of the Mediastinum: Case Report. Irving Greenfield, Israel Steinberg, and Arthur S. W. Touroff. J. Thoracic Surg. **12:** 495–502, June 1943.

In 1937 Churchill reported a case of a lobulated mass in the anterior mediastinum which proved to be a simple cyst lined with mesothelial cells, containing crystal-clear fluid. There were no structures by which it could be identified and Churchill called it a "spring water" cyst of the mediastinum.

The authors present a description of the second reported case of "spring water" cyst.

The patient was a forty-four-year-old woman who suddenly felt a severe constricting pain across the anterior portion of the upper chest. This gradually subsided but she continued to have heaviness substernally and slight discomfort on swallowing solid foods. Roentgenograms of the chest showed a round, smooth mass in the anterosuperior mediastinum, more on the left side than the right. Angiocardiography established that the origin was not from the heart or great vessels. The mass was removed surgically and was a thin-walled cyst containing crystal-clear fluid. The lining of the cyst was columnar epithelium, which is distinctly unlike the mesothelial lining in Churchill's case. The roentgenograms pre- and postoperative, as well as the angiocardiograms, are reproduced in the article. HAROLD O. PETERSON, M.D.

Angiocardiography in Congenital Heart Disease: Intracardiac Shunts. M. F. Steinberg, A. Grishman, and M. L. Sussman. Am. J. Roentgenol. **49:** 766–776, June 1943.

Eighteen cases of intracardiac shunts secondary to congenital cardiovascular disease have been studied by means of angiocardiography and form the basis of this paper. These included 10 cases of interatrial septal defects, 2 of interventricular septal defects, and 6 of transposition of the great vessesls, 4 of this last group showing the tetralogy of Fallot and 2 Eisenmenger's syndrome.

The value of angiocardiography in congenital cardiac septal defect depends upon the demonstration of a shunt between the right and left side of the heart, as well as the size of the cardiac chambers and great vessels. The method is of greatest value when a right to left shunt is present more or less constantly or, in other words, in the presence of cyanosis. Absence of cyanosis indicates that the pressure in the left heart is greater than in the right.

In the presence of interatrial septal defects the expected angiocardiographic pattern would include revisualization of the right auricle and ventricle after the opaque material had reached the left heart. This demonstration has not been achieved unequivocally because of the dilution of the contrast medium. In the presence of interventricular septal defects, revisualization of the right ventricle after it has emptied is to be expected. In transposition of the great vessels there is simultaneous visualization of the right ventricle, aorta, pulmonic artery, and left ventricle within two to three seconds of the beginning of the injection, due to the passage of opaque material directly from the right ventricle into the aorta.

Accurate clinical diagnosis is possible in most cases of intracardiac shunt but confirmatory evidence of value may be obtained. Angiocardiography is of particular value in the Eisenmenger complex because with conventional roentgenography the large pulmonary artery may obscure the presence of a dextraposed aorta. L. W. PAUL, M.D.

Multiple Saccular Aneurysms of the Aorta with Roentgen and Necropsy Findings. F. B. Mandeville. Virginia M. Monthly **70:** 293–296, June 1943.

While it is generally known that small aneurysms of the cerebral arteries are commonly multiple, the fact that more than one aneurysm of the aorta may occur is often overlooked in clinical and roentgen examinations. A review of the literature shows that multiple aneurysms do occur, though infrequently, the causes including syphilis, trauma, atheroma, and bacterial infection.

A colored male, aged 26 years, complained of a bad cold with pain in the left side over the lower chest, a severe barking cough, the expectoration of thick, clear, tenacious sputum, and severe epistaxis. The blood pressure varied in the two arms. There was a slight fever. Physical examination revealed slight bilateral cervical and submaxillary lymphadenopathy, abnormal breath sounds, and an expiratory grunt. The aortic arch was widened. The blood Wassermann reaction was four plus. There was a slight leukocytosis and slight anemia.

Postero-anterior and left lateral views of the chest showed a somewhat irregularly lobulated mass in the mediastinum, extending to both sides about equally and pressing the trachea forward and to the right. There was a small amount of fluid in the left lower chest, the left dome of the diaphragm was a little higher than the right, and the heart was not enlarged. Fluoroscopy showed a lobulated mass in the mediastinum with a slight transmitted pulsation and a fluid level at the left base. All the findings suggested a lymphoblastoma with small left pleural effusion.

Roentgen therapy was administered to the mediastinum as a diagnostic test, 1,000 r being given in five days. Re-examination three, ten, and seventeen days later showed no appreciable change in the size or appearance of the mediastinum. No expansile pulsation was noted nor was there any other typical evidence of aneurysm, although it was considered.

At necropsy the aorta was found to be distended by three saccular aneurysms in the arch, 1 cm., 3.5 cm., and 10 cm. in diameter. The smallest bulged anteriorly to the left; the second, somewhat horn-shaped, bulged to the right posteriorly; the third, 10 cm. in diameter, extended toward the right, pushing the trachea and esophagus ahead of it. When the esophagus was dissected from the tip of the aneurysm, it was found that practically no wall was left and that at this point the aneurysm was covered by soft adventitial

tissue of the esophagus. The microscopic diagnosis was syphilitic aortitis.

Sir William Osler's dictum that there is no disease more conducive to clinical humility than aneurysm of the aorta appears to be confirmed. The author suggests that "roentgen humility" be substituted for "clinical humility" and the word "multiple" be placed in front of "aneurysm." J. E. WHITELEATHER, M.D.

DIGESTIVE SYSTEM

Congenital Atresia of the Esophagus with Tracheoesophageal Fistula; Extrapleural Ligation of Fistula and End-to-End Anastomosis of Esophageal Segments. Cameron Haight and Harry A. Towsley. Surg., Gynec. & Obst. **76:** 672–688, June 1943.

In the last seven years there were seen in the University of Michigan Hospital 15 infants with congenital atresia of the esophagus. In 14 of these a tracheoesophageal fistula was known to be present. In 9 intrathoracic exploration was done with the intention of establishing continuity of the esophagus. Ligation of the fistula and anastomosis of the esophageal segments were accomplished in 5 cases; a successful result was obtained in one case, and the patient was alive eleven and a half months after operation. After the original preparation of the report, 9 additional cases were seen, and extrapleural ligation of the fistula and end-to-end anastomosis of the esophageal segments were done in 8 patients. Four of these were still alive after periods ranging from one to nearly eight months.

A positive diagnosis of esophageal obstruction is made by roentgenologic examination with an opaque medium or by the inability to pass a catheter into the stomach. In the presence of complete esophageal obstruction, the occurrence of a tracheoesophageal fistula is indicated by tympany or distention of the upper abdomen on physical examination and by the roentgen demonstration of air in the stomach. Endoscopy may be employed to establish the type of anomaly, but the authors believe it is unnecessary, except possibly in those cases without air in the stomach.

Iodized oil is administered under fluoroscopic control to determine the level of obstruction of the upper esophageal segment. The retained oil should be removed with a catheter at the completion of the examination to avoid the danger of aspiration. Fluoroscopic examination furnishes a more accurate means of determining the length of the upper segment than does roentgenography. If one considers the possibility of operative correction from a study of the films alone, the fact that the upper segment occupies a high position, as seen in the roentgenogram, is not necessarily a contraindication to surgical reconstruction, since on fluoroscopic study this segment may descend as much as the height of two dorsal vertebrae. Failure to visualize air in the stomach suggests the absence of a tracheoesophageal fistula, but this is not necessarily the case. In 2 of the authors' 3 patients in whom air was not demonstrated in the stomach roentgenologically, a small communication was found between the trachea and a narrow lower esophagus at operation.

The surgical correction of esophageal atresia is not an emergency procedure, and the time of operation depends upon the general condition of the patient. Atelectasis and lobular pneumonia have been frequently associated pathological conditions. Associated congenital anomalies are also of frequent occurrence. Included in the authors' series were congenital stricture of the ureter, anomalous right subclavian artery, pancreatic cysts, talipes cavovalgus, and fetal atelectasis.

The authors discuss the advantages of the various types of surgical procedure and also give in detail the technic followed in their successful case of esophageal reconstruction employing an extrapleural ligation of the fistula and end-to-end anastomosis. Postoperatively, roentgen examination with a portable unit should precede the administration of fluid by mouth. Fluoroscopy is deferred until the patient's condition warrants it. The chest should be examined roentgenographically the first several days after operation, to detect early atelectasis, bronchopneumonia, or pleural effusion. DAVID KIRSH, M.D.

Short Esophagus with Simple Peptic Ulceration. P. R. Allison, A. S. Johnstone, and G. B. Royce. J. Thoracic Surg. **12:** 432–457, June 1943.

The major part of this paper is made up of 10 case reports of short esophagus with peptic ulceration. All the patients were carefully studied roentgenographically and endoscopically, and reproductions of roentgenograms are included for each case. In many of the cases biopsy specimens were taken from above and below the cardiac sphincter, showing gastric mucosa on one side and esophageal mucosa on the other. A silver clip was attached to the mucosa at the junction of the two types of mucosa, and films were made to show the exact location of this junction.

Most of the patients are of middle age or older. They usually have pain half an hour to an hour after eating, located behind the sternum. Vomiting occurs sometimes, consisting usually in regurgitation of esophageal contents. Hematemesis may be profuse and even fatal. Dysphagia is the outstanding symptom and is probably of late occurrence in the natural history of the disease.

The diagnosis of a short esophagus depends on radiologic and endoscopic examinations. The chief roentgenographic finding is the difference in the mucosal pattern in the two areas. This is not always easy to determine, and the placing of a metal clip at the juncture, as ascertained by biopsy, is the most accurate method of locating the end-point of the esophagus. The patients were examined with thick and thin barium in the supine, prone, and upright positions. In all cases there was a stricture of the esophagus beginning from 6 to 11 cm. above the diaphragm. An ulcer crater was not always demonstrable roentgenographically but some degree of ulceration, diffuse or localized, was evident endoscopically.

While it cannot be denied that a congenitally short esophagus does exist, the authors feel that in many of these cases the short esophagus is acquired secondary to scarring and contraction from the presence of esophageal inflammation and ulceration of long standing.

Treatment consisted chiefly of dilatation and ulcer diet, with fairly good palliative results but no complete cures. HAROLD O. PETERSON, M.D.

Medical Aspects of Hiatal Hernia. Wm. H. Higgins. South. M. J. **36:** 273–276, April 1943.

An analysis of 65 cases of diaphragmatic hiatal hernia shows a remarkably diverse symptomatology which often complicates diagnostic studies of the abdomen and thorax.

Although most hiatal hernias are congenital, they generally do not produce symptoms until after middle life. The age factors concerned are stretching of the hiatus, decrease in supportive tissues about the hiatal ring, decreased elasticity, and increased intra-abdominal tension. Obesity is an important contributory factor. The patients in the author's series usually presented a long history, with such erroneous diagnoses as cholecystitis, peptic ulcer, cardiac disease, pleurisy, intestinal obstruction, etc. The most difficult diagnostic problems were encountered in instances where pain was referred to the sternum, neck, shoulder, or arm, closely simulating an anginal attack. Dysphagia was the most common symptom. The upright position and walking often brought relief of pain. Hiccough and hematemesis were sometimes observed. Roentgen studies are indispensable in diagnosis. A small hernia, however, is not infrequently missed. Esophagoscopy is advised in cases which are not readily or adequately diagnosed roentgenologically. MAX MASS, M.D.

Present Position of Gastroscopy in the Diagnosis of Gastric Disease. Moses Paulson. Am. J. M. Sc. **205:** 792-798, June 1943.

This article was written to point out when gastroscopy may or may not be indicated, and what may be expected from it. The flexible gastroscope came into being when it was learned that one could see through a curved tube if lenses of a very short focal distance were used. The instrument, which is 77 cm. long and 11 mm. in diameter, has an angle of deviation of 90 degrees and an angle of vision of 85 degrees.

In a comprehensive survey, a single death, ten perforations of the stomach, and one perforation of the jejunum in a resected stomach were reported in 22,951 examinations. Gastroscopy should not be attempted in aneurysms of the aorta or in strictures, cardiospasm, cancer, or varices of the esophagus. The examination is a matter of a few minutes and causes little discomfort. The ease of examination is such that the problem is not the insertion of the instrument but the orientation and interpretation of the examiner.

Gastroscopy has definite limitations. It visualizes the mucosa only. Biopsy specimens cannot be obtained, nor has photography been perfected. Small localized lesions may not be steadily seen due to changes in peristalsis and respiratory movements. Lesions of the lesser curvature, of the antrum and the upper third of the stomach are not always detectable. At times it may be difficult to distinguish between a benign and malignant lesion, or between cancer and hyperplastic gastritis. It is not what cannot be seen, but what can be seen that makes the instrument important.

Gastroscopy is in order whenever the roentgen-ray findings are negative and there is a persisting suspicion of some abnormality. As to the debate on how soon gastroscopy may be done following unexplained hematemesis or melena, the author's practice is to do it just as soon as the initial shock is over. Several types of gastritis have been described since the advent of the flexible gastroscope, but as yet there is no general agreement as to the extent to which gastritis may account for the complaints of these patients.

Not infrequently gross differentiation of benign from malignant lesions is made more correctly through the gastroscope than by roentgen ray, or at operation, or from the gross resected tissue, because the actual living tissue without disturbed blood supply is seen. Gastroscopy is definitely indicated where the roentgen findings are not conclusive or where they are inconsistent in relation to the clinical picture. Recurrence of symptoms following operative procedures on the stomach is an indication for examination to ascertain the presence of gastritis or recurrence of an ulcer or cancer. Gastroscopy should be done in all patients in whom there is the slightest suspicion of gastric cancer. BENJAMIN COPLEMAN, M.D.

Mistakes and Misunderstandings in the Roentgenologic Diagnosis of Gastric Cancer. B. R. Kirklin. Arch. Surg. **46:** 861–864, June 1943.

This paper, forming a part of a symposium on gastric cancer, discusses the errors, both real and imputed, in the roentgen diagnosis of gastric cancer. Failure to discover the lesion is the fault of the individual rather than the method, since any cancer capable of producing symptoms or visible macroscopically can be demonstrated. A certain number of errors are, of course, inevitable from human negligence, but fortunately these amount to less than 1 per cent of the cancers examined. Differentiation of malignant from benign lesions is often difficult; small juxtapyloric lesions are a notorious source of error. It is sometimes impossible to determine whether an ulcer is prepyloric or postpyloric. Such errors, however, are small in number compared with misunderstandings by clinicians and surgeons as to the reservations implicit in certain roentgenologic diagnoses and reports. Most of these misunderstandings arise from the diagnosis of benign tumors and gastric ulcer, and from reports as to the operability of cancer.

Benign tumors have a characteristic appearance, and are usually diagnosed without difficulty. A fairly large percentage of these have small areas of malignant degeneration present when examined microscopically. The roentgenologist is prone to assume that the clinician will remember this possibility; while the clinician generally charges him with an error when the pathological report indicates malignant change. Benign and malignant types of ulcer are usually readily distinguishable, but in a certain proportion only a diagnosis of ulceration can be made, with the presumption of benignity implied by the absence of a contrary diagnosis. This leaves the fact that about 10 per cent of such ulcers are malignant to be allowed for by the clinician, who sometimes assumes that the lesion is benign, to the subsequent surprise and vexation of all concerned. While it is possible for the roentgenologist to cover such a contingency in his report, such a report would hardly be complimentary to the intelligence of the other consultants.

The estimation of operability depends on the technical skill of the surgeon as well as the anatomical extent of the disease. Unless the roentgenologist is thoroughly familiar with the customs of his surgical colleagues his estimates of operability may prove a source of dissension. Metastases to the abdominal nodes, which cannot be determined roentgenologically, are a very frequent cause for the abandonment of operation in an otherwise resectable growth. Since about half the apparently resectable cases prove on operation not to be so, roentgenologists would probably do better not to make any statement on this score, since operability can be determined only by exploration.

LEWIS G. JACOBS, M.D.

Multiple Gastric Polyposis. A Supplementary Report of 41 Cases, Including 3 New Personal Cases. Felix L. Pearl and Harold Brunn. Surg., Gynec. & Obst. **76:** 257–281, March 1943.

This paper is an analysis of 41 cases of gastric polyposis in which 3 or more polyps were present, including 3 personal cases. All these have been collected since the authors' earlier report of 84 cases (Surg., Gynec. & Obst. **43:** 559, 1926).

Multiple gastric polyposis is not common, though many cases are undoubtedly overlooked because of lack of symptoms. It may be congenital (neoplastic) or inflammatory (hyperplastic). The two types may often be differentiated on gross examination alone. There are no symptoms which are characteristic of this disorder. In the authors' series, epigastric pain and tenderness were most frequent. In over half of the cases, blood was found in the vomitus, stool, or gastric contents. Physical findings are indefinite and may be entirely lacking.

Diagnosis is attended by considerable difficulty. The x-ray may fail to differentiate multiple polyposis from chronic hypertrophic gastritis, retained food, bezoar, or sarcoma. In the present series of 41 personal and collected cases, the correct diagnosis was made by x-ray in 17, by operation in 13, by examination of the excised surgical specimen in 5, and by autopsy in 6. Gastroscopy is a valuable aid especially in the differentiation between benign and malignant lesions and between polyposis and hypertrophic gastritis. The combined use of roentgenography and gastroscopy will afford increased accuracy of diagnosis. Examination of the gastric content is of great importance. Of 24 cases in which it was done, 22 showed no free hydrochloric acid. The presence of anacidity in multiple polyposis is even more common than in carcinoma. A careful search should be made in the gastric content for tumor particles which may establish the diagnosis.

In the authors' previous series malignant alteration was noted in 12 per cent; of the present series, data as to malignancy were omitted in 4 of the cases; malignant alteration was found in 19. This alone, the authors believe, argues for radical surgical removal by gastric resection once the diagnosis is made.

Details of the 37 cases from the literature are given in tabular form and the authors' 3 cases are reported in detail. Illustrations and a bibliography of 119 references are included.

Fibroma of the Stomach: A Case Report. H. M. Wiley. J. Missouri M. A. **40:** 171–174, June 1943.

Benign tumors of the stomach are infrequent, often being incidental findings on postmortem examination. While they may be asymptomatic, they also may mimic a malignant neoplasm. Roentgen examination is best suited for diagnosis. A circumscribed defect is found, frequently on the gastric walls, not affecting the curvatures. The surrounding rugae are usually normal in their arrangement. There is little disturbance of peristalsis, and retention is uncommon unless the lesion is at the pylorus.

The author's patient was a male, aged 51, in whom a diagnosis of a gumma of the stomach was first made. This was later changed to gastric carcinoma, and a subtotal gastric resection was done. The microscopic diagnosis was fibroma of the stomach.

HENRY K. TAYLOR, M.D.

Roentgenologic Changes in the Small Intestine in the Presence of the Hookworm. George R. Krause and James A. Crilly. Am. J. Roentgenol. **49:** 719–729, June 1943.

Roentgenologic studies of 44 patients with clinically significant hookworm disease demonstrated the presence of abnormalities of the small intestinal pattern similar to those described by others as the "deficiency pattern" in 40 cases; in 26 of these the changes were classed as moderately severe or severe. Of 53 patients with asymptomatic incidental hookworm infestation, 33 had a normal small intestine, 16 showed minimal variation from the normal, and only 4 had severe alterations of the normal pattern. The hookworm itself is too small for roentgenographic demonstration. In the more advanced cases irregularities of the mucosa were present and occasionally the mucosal pattern was entirely obliterated. Flocculation was always present in the moderately and severely altered small intestine. Alterations in muscular function were frequently observed in the form of hypermotility with localized areas of segmentation, but hypomotility and dilatation were characteristically seen only in far advanced cases.

Twenty-nine patients were re-examined after successful anthelmintic therapy at intervals varying from five weeks to six months. Of 11 of these who had moderately or severely damaged small intestine, 8 showed improvement and 3 showed no change. None returned to the normal after therapy. This confirms the experience of others reporting on deficiency patterns due to other causes, in that severely distorted small intestines may return toward but not to the normal. The cause of the changes is still obscure.

L. W. PAUL, M.D.

Intestinal Strangulating Obstruction with Negative Roentgenologic Findings. Leon Goldman. Surgery **13:** 834–846, June 1943.

The difficulties of recognizing internal intestinal strangulating obstruction are well known. The pain may simulate that of perforated peptic ulcer, twisted ovarian cyst, acute pelvic inflammatory disease, or mesenteric infarction or thrombosis. The venous return is often occluded first, so that the involved loop quickly fills with blood, which usually replaces any gas that may be present. The physical findings simulate those of peritonitis rather than simple intestinal obstruction. The presence of fever, tenderness, rigidity, a palpable abdominal mass, or leukocytosis is usually evidence that the blood supply has been interrupted.

Four case reports are given. Three of the patients were women of middle age or older who had had operations from eight to sixteen years before the onset of the the present illness; the fourth was a 34-year-old man who had an appendectomy six years previously. In each case the onset was marked by a sudden cramplike pain, becoming continuous and spreading over the entire abdomen, followed by vomiting. On entrance to the hospital all patients showed fever and leukocytosis and in 3 a palpable abdominal mass was present. Roentgenograms failed to show any small bowel distention or fluid, although in all some gas was demonstrable in the stomach or large bowel. Operation was done in each instance shortly after the x-ray was made and sections of gangrenous small bowel of various extent were found. The obstruction was due in every case to a fibrous band, which also occluded the mesen-

teric blood supply. The obstructed loops were heavy and filled with sanguineous fluid and there was serosanguineous fluid in the peritoneal cavity.

The interest aroused by these cases, with few or no roentgenologic evidences of obstruction on the plain film, stimulated experimental work in an attempt to explain the mechanisms involved. In order to simulate more closely the mechanism of internal strangulating obstruction, a method was devised for the gradual production of experimental strangulation. Changes which take place when a loop of intestine and its blood supply are gradually constricted are venous engorgement, perivascular hemorrhage, venous stasis, edema, cyanosis, spasm of the affected loop of bowel, and hemorrhage into the lumen and wall of the bowel. The mesentery becomes edematous so that the arterial supply is also encroached upon at the neck of the constriction and the lumen of the bowel is occluded, thereby setting up a vicious cycle, until perforation and peritonitis take place or a sufficient hemorrhage accumulates in the long segment to be an added factor in causing shock or death.

Three groups of experiments were carried out.

In *Group I* sudden obstruction was produced by ligating a loop of ileum, 40 cm. in length, with its blood supply, approximately 75 cm. proximal to the ileocecal valve. Subsequent roentgen study showed evidence of accumulation of gas and fluid proximal to the strangulation within ten hours in all the animals, the earliest appearing in two and a half hours.

In *Group II* a loop of ileum 40 cm. long with its mesentery was exteriorized over a linen string, the height of which could be regulated above the level of the anterior abdominal wall. The loop was permitted to hang apron-like over the string. The height of the string was then adjusted to a level that would produce venous engorgement. The bowel was handled gently and kept warm. In some dogs arterial pulsation disappeared within two and a half hours and in others continued for six hours. X-ray films, made within six to ten hours, showed definite accumulations of gas in 7 of the animals. In 3 no gaseous accumulation or distention occurred proximal to the obstruction.

In *Group III* 10 dogs were treated in a similar fashion except that the loop was left in the abdomen and the linen string anchored to the lateral border of the rectus sheath on each side. The string was placed under sufficient tension that engorgement of the venous return occurred. The x-ray films of 8 of the 10 dogs showed evidence of obstruction as characterized by gaseous distention of the small bowel. These findings occurred at six hours in 2, at twelve hours in 3, and at eighteen hours in 3 animals. The other 2 showed no roentgen evidence of gaseous distention after twenty-eight hours. The bowel was gangrenous and autopsy disclosed thrombosis of the involved mesenteric veins.

Discussing these observations, the author points out that roentgen evidence of obstruction was absent in from 20 to 30 per cent of the animals in which occlusion was produced gradually. It is considered possible that mesenteric venous occlusion may occur, causing a state of gangrene in the bowel before the lumen is obstructed, or that the occlusion may provoke a profusion of irritating serosanguineous fluid resulting in an inhibition of peristalsis and signs of peritonitis so that the x-ray films suggest adynamic ileus or no findings at all. It is suggested, also, that the irritative effect of a band or hernial ring may, by damage of the intima, initiate a venous thrombosis as is produced by simple ligation of a blood vessel.

J. E. WHITELEATHER, M.D.

Carcinoma of the Large Bowel, Excepting the Rectum. O. Häuptli. Schweiz. med. Wchnschr. **73:** 737–741, June 5, 1943.

The author discusses at length the symptoms, complications, prognosis, and treatment of cancer of the proximal colon. He prefers a one-stage radical hemicolectomy, but on occasion employs a two-stage or three-stage operation. In a series of 57 operable cases, there were 29 cures and 28 deaths from various causes. Three of 12 patients with inoperable cancers were living after palliative operations.

LEWIS G. JACOBS, M.D.

Solitary Diverticulitis of the Cecum. Joel W. Baker and Thomas Carlile. J. A. M. A. **122:** 354–356, June 5, 1943.

Thirty-seven cases of solitary diverticulitis of the cecum have been found in the American and British literature. This excludes cases in which more than one diverticulum was present and those in which the pathological condition was not primarily diverticulitis. The authors report two more cases and present an interesting analysis of the clinical pictures and operative findings in the collected series of 39 cases. The mortality rate was one out of the 39.

The conclusion is reached that solitary diverticulitis of the cecum cannot be differentiated from appendicitis, that the operative differential diagnosis is of the utmost importance in determining the type of procedure to be followed, and that the outlook is favorable for complete recovery.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

Endometriosis: A Study of 117 Cases with Special Reference to Constricting Lesions of the Rectum and Sigmoid Colon. E. L. Jenkinson and W. H. Brown. J. A. M. A. **122:** 349–354, June 5, 1943.

The authors state that the importance of endometriosis as a cause of constricting lesions of the rectum and sigmoid colon has not been sufficiently stressed, resulting in overly frequent confusing of the condition with neoplasm or inflammatory disease, with subsequent needless resection or fruitless medical management. They show by their own series, substantiated by the reports of others, that the incidence of endometriosis involving the rectosigmoid colon is considerably higher than might be expected. Of 117 cases of endometriosis, 47 showed at operation varying degrees of involvement of the rectosigmoid colon.

The history and symptomatology are important. Of the 47 patients, 21 had symptoms indicating some degree of obstruction, and of these, 14 gave a history of exacerbation of the bowel symptoms during or just before menstruation. The average duration of symptoms tends to be longer than for carcinoma. The incidence of gross or occult blood is low, since in most cases only the serosa and muscular layers are appreciably involved. This similarly decreases the diagnostic value of sigmoidoscopy and biopsy.

Roentgenologically the lesions are characterized by a long filling defect having sharp regular borders, intact mucosa, inconstancy of the filling defect, and fixation

of the bowel, which is exquisitely tender to palpation. In the less advanced cases there was a well demarcated, localized, irritable segment, usually three to five inches long and quite tender on palpation, especially before or during menstruation.

All constricting lesions in this series had returned to normal caliber when examined more than two months after surgical castration.

DEPARTMENT OF ROENTGENOLOGY
UNIVERSITY OF MICHIGAN (R. H. M.)

THE SPLEEN

Cysts of the Spleen. John W. Snyder and Philipp R. Rezek. South. M. J. **36:** 263–268, April 1943.

Some 108 cases of non-parasitic cysts of the spleen had been reported in the literature up to 1941. By contrast, echinococcus cysts are relatively common. Cysts of the spleen may be classified as primary, which includes congenital, traumatic, inflammatory, neoplastic, and parasitic conditions; (2) secondary or false cysts, which may be traumatic, degenerative, or inflammatory.

This paper is concerned mainly with the clinically more important secondary group. Fowler has written extensively on the subject (see, for example, Surg., Gynec. & Obst. **70:** 213, 1940), and the authors quote freely from his papers. He found trauma to be an etiologic feature in 23 per cent of his cases. Of his traumatic group, 80 per cent were large solitary hemorrhagic cysts, 15 per cent were serous, and 5 per cent lymphatic. Clinical symptoms, although numerous, are not pathognomonic, being largely the result of pressure upon the neighboring organs. Roentgen study may demonstrate a downward displacement of the splenic flexure, which is of great diagnostic significance. The stomach tends to be displaced to the right and backward. Pressure on the kidney may result in distortion and displacements in the pyelogram. Splenectomy is the treatment of choice.

The case of a 37-year-old white woman, in the fourth month of pregnancy, is presented. Her chief complaint was an abdominal mass in the left flank. An exploratory laparotomy was performed and a huge hemorrhagic cyst was encountered. After aspiration a splenectomy was performed. The patient made an uneventful recovery and later was delivered of a normal child by cesarean section. The cyst was believed to be lymphogenous in origin with superimposed hemorrhage.

A bibliography is appended. MAX MASS, M.D.

THE SKELETAL SYSTEM

Variability in Onset of Ossification in Epiphyses and Short Bones of the Extremities. Idell Pyle and L. W. Sontag. Am. J. Roentgenol. **49:** 795–798, June 1943.

Tables are presented showing the time and order of onset of ossification of the epiphyses and short bones of the extremities in boys and girls. Children studied include 64 boys and 69 girls, all white and American born. Many of these subjects were observed roentgenographically from birth to the age of nine years. Standard deviations and coefficients of variability are presented.

Carpal and tarsal bones are definitely more variable in time of appearance than are true epiphyses. However, no marked difference in order of ossification in advanced or retarded children or those growing at an average rate was observed. There was no evidence in the material examined that illnesses common to this age level had a specific delaying action on centers due to calcify just at the time when the illness occurs.

L. W. PAUL, M.D.

Development of the Vertebral Column as Related to Certain Congenital and Pathological Changes. J. L. Ehrenhaft. Surg., Gynec. & Obst. **76:** 282–292, March 1943.

The purpose of this paper is to discuss the development of the vertebrae and intervertebral disks and to point out the embryologic basis of certain confusing lesions encountered in later life. Not all developmental defects in the vertebrae-disk column can be explained on the basis of malformations in the mesenchymal and cartilaginous embryonic states. Many, however, become easily understandable if one considers the vascular supply and the changes which occur in the notochord during the different stages.

Congenital synostosis, with complete or partial bony fusion of two or more vertebral bodies with no evidence of interposed intervertebral disk tissue, or possibly only small amounts, occurs on the basis of a complete regression of the primitive annulus fibrosus.

Sagittal cleft vertebrae are due to a persistence of the ventrodorsal extension of the perichordal sheath with or without persistence of the chorda or splitting of the notochord in this area. Fusion of the laterally situated cartilaginous vertebral halves may thus be prevented and each half may become ossified separately by its anterior and posterior centers, with persistence of the sagittal cleft. With subsequent weight-bearing, the so-called "butterfly vertebral bodies" may occur.

Lateral half vertebrae or wedge vertebrae may be either unilateral or bilateral. They have been attributed to failure of cartilaginous development and to lack of blood supply to the missing half of the vertebral body. Bilateral half vertebrae are most commonly explained on the basis of a faulty unilateral cranial hemimetameric shift of the vertebral segments in the blastemic period. This shift will cause an anlage for a half vertebra to remain at the lower and upper ends of the unequally shifted column, which will later undergo chondrification and ossification.

Ventral and dorsal half vertebrae are rare and are explained on the basis of faulty vascularization and agenesis of either the anterior or posterior center of ossification. The malformed vertebral bodies will at times take the form of wedges as soon as weight-bearing is started, resulting in a deformity of the gibbous type.

Malformations of the chorda and chordal remnants result from the migration of notochordal cells during the cartilaginous period of embryonic development. Among the more frequent abnormalities are the outpouchings of the otherwise normal intervertebral disk, usually associated with thinning of the cartilage plate in the zones where the mucoid streak entered the intervertebral disk. These weakened places are often the site of centrally placed nuclear prolapses.

Congenital weakness of the cartilage plates. In areas where the cartilage plates are penetrated by vessels from the vertebrae, chondrification gaps develop. These areas form points of lessened resistance to the increased turgor of nuclear material, and at times the latter will be forced through these gaps to form spongiosal prolapses. If this occurs during the actively growing state of the adolescent period, the process will

be a rather gradual one, stimulating considerable cartilage formation, but little reactive bone. Thus, often no reactive bony cup can be seen early in the x-ray pictures. Also, no true tears of the cartilage plate will result. In older persons, the prolapsing material is more of a fibrous nature and the reparative process proceeds rapidly to reactive bone and a bony cup becomes visible in x-ray pictures.

Osteomyelitis of the Long Bones in the Newborn. Samuel Stone. Am. J. Dis. Child. **64:** 680–688, October 1942.

Osteomyelitis of the long bones in the newborn is uncommon, and since it differs in its course and prognosis from osteomyelitis in older children, the author has reviewed the reports thus far appearing in the literature.

The report of Green and Shannon in 1936 (Arch. Surg. **32:** 462, 1936) emphasized the difference between osteomyelitis in infants under two years of age and the disease in older persons. The streptococcus was the etiologic organism in 63 per cent of the cases. Wounds healed rapidly after operation, frequently in from four to six weeks. Sequestration was infrequent. Healing of the lesion was so complete that in many instances the site could not be recognized in the final roentgenogram. Subperiosteal new bone was visible much sooner than in older children. Immobilization, poultices, and supportive treatment was the usual procedure in these cases. Operation was not performed unless a palpable mass was present.

While osteomyelitis in the newborn child may be a benign disease, it is pointed out that in the presence of sepsis with metastatic foci the prognosis is grave.

The author adds 4 cases to the literature and comments on the benign course in each case, the quick healing of the osseous lesions, the rapid subperiosteal new bone formation, short period of drainage, and complete healing without sequestration. It is noted that the vascular spores in the bones of infants are larger and the bone of a more spongy texture than in older children; also that the cortical bone is particularly thin at the metaphysis and the periosteum is more loosely attached. All of these factors allow more rapid decompression of pus and decrease the incidence of gross sequestration. The fact that necrotic bone is more rapidly absorbed in infants and that new bone is formed more rapidly also helps to explain the benign course of the disease and the excellent prognosis.

GEORGE M. WYATT, M.D.

Syphilitic Spondylitis. Eugene Freedman and I. Meschan. Am. J. Roentgenol. **49:** 756–765, June 1943.

The literature on syphilitic spondylitis is reviewed and the authors report 3 cases observed by them. The lesion shows a marked predilection for involvement of the cervical vertebrae, for reasons unknown. The symptomatology is not definite. There are localized pain, which may be more marked at night, stiffness, and tenderness to palpation as the result of periostitis. Roentgenologic examination shows evidence of destruction of the vertebral bodies, especially on their ventral aspect, but there also is a strong tendency to osteosclerosis and hyperostosis. There usually is calcification in the anterior and lateral ligaments, leading eventually to complete ankylosis. The tendency to eburnation predominates over the tendency to destruction. The intervertebral space may be narrowed or of normal width. In the cervical region the ligaments tend to ossify in a rather uniform and smooth fashion, while in the lumbar or dorsal areas, large pointed spurs may develop along the anterolateral borders of the end plate. Such appearances may simulate a degenerative arthritic process. Significantly, in syphilitic spondylitis the process is usually localized to two or three vertebrae in contrast to the more widespread changes in degenerative lesions.

While the roentgen appearance may suggest the possibility that a syphilitic spondylitis is present, other factors are necessary to substantiate the diagnosis, including evidence of active syphilis, either as determined by the history or by clinical or serological manifestations; development of the lesion at an age when tuberculosis of the spine is rare, and with an absence of tuberculosis elsewhere; rapid improvement upon institution of antisyphilitic therapy, and the predilection of the disease for the cervical region, although it may occur elsewhere in the spinal column.

L. W. PAUL, M.D.

Anterior Sacral Meningocele. Frederick A. Coller and Richard G. Jackson. Surg., Gynec. & Obst. **76:** 703–707, June 1943.

Anterior sacral meningocele is a rare condition, only 22 cases having been previously reported in the literature. Eighteen patients were treated. Of these, 8 were cured, 2 remained the same, and 8 died. If the condition is unsuspected, inadvertent opening or aspiration of the sac may lead to meningitis.

The meningocele enters the pelvis through an anterior defect, which is usually laterally placed. However, the tumor may herniate through the sciatic foramen and present posteriorly. The diagnosis is suggested by a life-long history of constipation, palpation of a fluctuant retrorectal tumor, and x-ray demonstration of a sacral deformity. Treatment should be conservative unless the symptoms are severe or the danger of the meningocele complicating pregnancy arises. Operation consists in approaching the tumor through a posterior mid-line incision, ligating and sectioning the pedicle. The wall of the sac does not have to be excised, since it does not secrete spinal fluid.

The author presents the record of a case successfully treated surgically. An x-ray film of the pelvis showed profound deformity of the sacrum, suggesting nondevelopment of the right half, displacement of the left half toward the left, and displacement of the coccyx to the horizontal position. A barium enema showed the rectum displaced and compressed, and the sigmoid displaced upward. The left innominate bone was rotated somewhat and the sacroiliac joints were slightly widened. The bone margins were smooth and not eroded. The preoperative diagnosis was a developmental lesion which might be a dermoid or anterior sacral meningocele. Surgical treatment, consisting of ligation of the pedicle, was successful.

DAVID KIRSH, M.D.

Multiple Cystic Tuberculosis of Bone. F. Ziady and G. Selzer. Clin. Proc. (Cape Town, South Africa) **1:** 346–356, October 1942.

A case of multiple cystic tuberculosis of the bone is described. The patient, a colored girl seven months of age, had a generalized lymphadenopathy, with nodes of varying size. Behind the left ear was a deep sinus from which pus was oozing; this communicated with the middle ear and mastoid.

Roentgenograms revealed a multitude of lesions diffusely scattered throughout the body. X-rays of the skull showed several well defined areas of erosion in the frontal and the parietal regions, with some linear periosteal proliferation of the lower part of the frontal bone. In the long bones, carpal and tarsal bones, and ribs were multiple areas of translucency of various size; there was some periosteal proliferation of the linear type along the shafts of the humeri, femora, tibiae, and fibulae. The lower end of each femoral diaphysis was expanded. A greenstick fracture of the upper end of the left tibia was present. Films of the chest showed scattered rounded areas of opacity in the lung fields, larger than those seen with miliary tuberculosis. The blood Wassermann reaction was strongly positive.

Diagnosis was difficult, the following conditions being suggested: generalized tuberculosis, Boeck's sarcoidosis, syphilis, a lipoid disturbance of the Hand-Schüller-Christian type.

At autopsy the nodes, bony lesions, and pulmonary lesions were shown to be due to tuberculosis.

Syndrome of Atlanto-Axial Dislocation. G. M. Bull. Clin. Proc. (Cape Town, South Africa) **1:** 336–345, October 1942.

The author gives a brief description of the anatomy of atlanto-axial dislocation and classifies the types of dislocation of the atlas on the axis as (1) fracture of the odontoid process with subluxation of the atlas on the axis (the most frequent type of dislocation); (2) rotary dislocation of the atlas on the axis, due to excessive rotation of the head on the trunk; (3) simple subluxation of the atlas and the skull on the axis without fracture of the odontoid. This type of dislocation is extremely rare.

Two cases are presented: one of anterior dislocation of the atlas on the axis with fracture of the odontoid peg and the other a very unusual case of forward dislocation of the atlas on the axis without fracture of the odontoid.

Traumatic Dislocation of the Hip with Fracture of the Acetabulum. Alfred M. Okelberry. Minnesota Med. **40:** 378–383, June 1943.

The hip joint is susceptible to injury in three periods of life: infancy, old age, and under certain circumstances in middle life. In cases of traumatic dislocation, fracture of the acetabulum may be a complication; it occurs when the hip is not adducted and when the femoral head is still partly in contact with the acetabulum.

Campbell divides dislocation with acetabular fracture into three types: (1) slight backward and upward displacement of the femoral head; (2) displacement of the femur more than a half-inch upward; (3) displacement of the femoral head upward and backward onto the wing of the ilium.

The author discusses treatment. If traction fails, open reduction is resorted to. Three case histories are presented.

The author comments on the possibility of aseptic necrosis occurring in dislocation of the femur. Quoting Potts and Obitz, he states that this may be delayed until as long as five years following injury. [There will be many to question this concept. As we have come to understand aseptic necrosis of the femoral head as presented to us by Phemister and others, the occurrence of such a process after five years of active weight-bearing is certainly not well understood, and even less well understood would be the manner in which a reparative "creeping substitution" would operate. Furthermore, the roentgenogram presented by the author as evidence of aseptic necrosis is not convincing].

PERCY J. DELANO, M.D.

Arthroplasty of the Hip for Osteoarthritis, Utilizing Foreign-Body Cups of Plastic. Paul H. Harmon. Surg., Gynec. & Obst. **76:** 347–365, March 1943.

This presentation deals with two subjects: arthroplasty utilizing foreign substances of non-animal origin and end-results of these and other methods in ameliorating pain and disability in osteoarthritis of the hip. Late results, approximately eighteen months following foreign body cup arthroplasty of the hip, are reported in 13 cases (16 hips). Results have been "excellent" in 10 hips or 62.5 per cent, "good" in 3 hips or 18.7 per cent, and "poor" in 3 hips or 18.7 per cent. It is the author's impression that the relief from pain is definitely greater with the use of the plastic cup (molded from sheet material) than following metallic cup arthroplasty. Surface hardness of the interposed material probably is the responsible factor, since relief from pain was far less in 3 patients upon whom an arthroplasty with a pure fused quartz cup was used. A simplified operative technic is described which is applicable in the presence of a movable hip. The plastic cup also has the advantage of being transparent to the roentgen ray, so that osseous changes occurring in the hip can be visualized.

The gross and microscopic alterations of the osteoarthritic femoral head, based upon the study of roentgenograms of 94 osteoarthritic hips and the direct observation of approximately 60 osteoarthritic hips at operation, are described. The changes to be seen in roentgenograms of the "early osteoarthritic hip" include marginal osteophytes at the head and neck junction or at the lateral acetabular margin, widening of the femoral head by growth of its adductor portion as seen in the anteroposterior film, and sclerosis within the head and above the acetabular articular bony cortex (supra-acetabular sclerosis). At this time the superior "joint space" may be normal or slightly diminished. As further changes take place, spotty sclerosis appears in the head, denoting osseous infarction or endosteal proliferation. Marginal osteophytes increase in size and especially the adductor portion of the head becomes disproportionate. In advanced cases the adductor osteophyte may be half as large as the head itself and may cause partial dislocation of the latter. This portion of the head may render the femoral head egg-shaped and be a major factor in causing it to be difficult to dislocate at operation and in restricting motion of the joint. The head increases in size both by subchondral sclerosis and by its enlargement by osteophytic proliferation. Subchondral sclerosis is accompanied or preceded by changes in cartilage. As a result, irregular islands of cartilage thinning occur, which in advanced states may bare subchondral bone. Cartilage is thrown up into pleat and ridge formation, the whole giving the head an irregular appearance. The extent of marginal overgrowth of bone and cartilage never parallels the rate of degeneration of cartilage over the head and of actual enlargement of the osseous structure of the latter. Consequently, osteoarthritic femoral heads are never identical.

Most of the alterations which are seen in the customary anteroposterior roentgenograms of the hip and which appear to be acetabular osseous overgrowths are actually alterations on or in the femoral head. Such roentgenograms seldom give an accurate impression of the relative changes in the femoral head and acetabulum as actually visualized at operation. Lateral views of the hip with leg abducted and externally rotated are of help in visualizing the extent of relative involvement of the femoral head prior to operation.

The operative technic is described and case reports, with illustrations, are included.

OBSTETRICS AND GYNECOLOGY

Roentgenographic Obstetrical Pelvicephalometry in the Erect Posture. Robt. P. Ball and Ross Golden. Am. J. Roentgenol. **49:** 731–741, June 1943.

One of the authors previously had described a method of roentgen pelvimetry and fetal cephalometry which involved the determination of the volume of the fetal head from circumference measurements taken from right-angle views (Radiology **24:** 77, 1935; **31:** 188, 1938). For the past five years the erect position has been used for this purpose in order to eliminate the possibility of a change in the relation of the uterus to the axis of the maternal body when the patient is turned from the anteroposterior to the lateral position. The present paper describes the technic used in making the roentgenograms and discusses their interpretation with particular reference to the quantitative relationship between the size of the fetal cranium and the maternal bony pelvis. A previously described nomogram is used to calculate the pelvic diameter.

The diameters measured include the anteroposterior and transverse of the inlet, the interspinous, intertuberous, base of the subpubic arch, sagittal diameter of the fore pelvis and of the posterior pelvis. The roentgen report includes, also, a description of pelvic configuration.

The total volume of the fetal cranium is calculated from the mean circumference measurement of the cranial image as seen in right-angle view. In any pelvis the obstetrical conjugate or the biischial spine diameter will be the smallest internal pelvic diameter. If the mean circumference measurement of the fetal head plus scalp is translated into units of volume, it can be compared to the volume capacity of one of these internal pelvic diameters, *i.e.*, to the volume of the largest sphere which could pass through. When the volume of the head is less than the volume capacity of either of these diameters, there is no bony disproportion present. Even when the volume of the fetal head is greater than the volume capacity of either diameter, important bony disproportion is not necessarily indicated, if molding of sufficient degree can occur, thus reducing the size of the head in the direction of the narrow diameter, or if compensatory space is present so that the widest portion of the fetal head does not have to pass through the narrowest pelvic diameter. Because of the variables involved, namely, uterine force, molding, and the amount of compensatory space, arbitrary limits cannot be set. As a general principle, however, it can be stated that the smaller the pelvis and the greater the excess of fetal head volume over the volume capacity of the smallest pelvic diameter, the greater the danger of difficulty in delivery.

L. W. PAUL, M.D.

Analysis of Roentgen Pelvimetry by the Johnson Stereoroentgenometer in 379 Cases. J. N. Ané and Leon J. Menville. Am. J. Roentgenol. **49:** 742–749, June 1943.

The method of roentgen pelvimetry previously described by Johnson (Radiology **8:** 518, 1927) was used by the authors in the study of 450 consecutive obstetrical patients. The average diameters in these cases are shown in tabular form. Information relative to the type of delivery was obtained in 379 patients. Analysis of the pelvic diameters obtained in these 379 cases showed that in 216, or 56.9 per cent, all diameters were normal or greater than the accepted average diameters; in 95 patients, or 25.1 per cent, one or more were shortened from 5 to 10 mm.; and in 68 cases, or 17.9 per cent, diameters were contracted over 10 mm. In a series of 205 patients with normal diameters as determined by the stereoroentgenogram, 203, or 99 per cent, had normal deliveries. In a group of 61 patients in whom more than one diameter was contracted more than 10 mm., 52, or 85.2 per cent, had difficult or prolonged labors or required operative deliveries.

This study emphasizes the importance of the interspinous or transverse diameter of the mid-plane in pelvimetry. Of 45 patients with contraction of the interspinous diameters of over 10 mm., only 3 delivered normally.

The authors conclude that the Johnson method of stereoroentgenometry combined with the stereoscopic study of the relationship of the bony pelvis and the fetal skull is of considerable value in the prognosis of the future course of pregnancy. L. W. PAUL, M.D.

Comparative Value of Roentgen versus Clinical Methods of Pelvic Examination in Obstetrics: Roentgenologic Aspects. Samuel G. Henderson. Pennsylvania M. J. **46:** 902–906, June 1943.

Roentgen studies are of primary importance in disclosing pelvic configuration and relative size of the fetus and maternal pelvis. Studies are best made late in pregnancy, as in the early months x-ray may hold an element of danger to the fetus. Furthermore, if the studies are made in the ninth month of pregnancy, a statement can be made concerning the relative size of the fetus and maternal pelvis.

To be of most value a technic must be simple, practical, and technically accurate; it should give the size and shape of both the inlet and outlet of the pelvis. The author employs the perforated plate method, using three films, anterior-posterior, lateral, and a film of the subpubic arch. He also uses precision stereoscopy as outlined by Caldwell and Moloy.

Female pelves are divided into four types, gynecoid, android, anthropoid, and platypelloid, each major type having modifying characteristics ordinarily seen in the other major groups.

A roentgenologist's description of the pelvis should include its type, the inlet and the angle of the forepelvis, whether average, narrow, or wide, and the slope of the pelvic sidewalls. In the lateral view the configuration of the pelvis should be determined—whether flat, concave, or convex anteriorly. The true conjugate, posterior sagittal diameter, and the size and shape of the sacrosciatic notch should be described. The fetal skull is measured in its greatest sagittal and transverse diameters.

In a study of 329 pregnant women there were 233

gynecoid, 14 android, 45 anthropoid and 37 platypelloid types of pelvis. Vertex presentations were found in 291 cases, breech position in 27, transverse position in 2, and face position in 1. Twins were present in 5 cases. Cephalopelvic disproportion was diagnosed in 94 patients; it was marked in 18, moderate in 54, and borderline in 22 cases.

A paper on the clinical aspects of pelvic examination follows this contribution. See following abstract.

JOSEPH T. DANZER, M.D.

Comparative Value of Roentgen versus Clinical Methods of Pelvic Examination in Obstetrics: Clinical Aspects. Howard A. Power. Pennsylvania M. J. **46:** 907–909, June 1943.

This paper follows one on the roentgenologic aspects of pelvic examination, abstracted above. Two hundred and twenty-nine of the women who were studied roentgenologically were also examined clinically. The two examinations were in complete agreement as to the type of pelvis in 98 cases; they disagreed at least partially in 131, and in 88 cases there was absolute disagreement. In evaluation of disproportion there was agreement in 174 instances and disagreement in 55. Most of these disagreements represented borderline disproportion. In 16 cases in which the clinical opinion was questionable and the x-ray showed no disproportion, x-ray opinion was correct in the entire group. In 4 cases in which the clinical opinion was questionable and the x-ray showed disproportion, x-ray opinion was correct in 3. The x-ray opinion was also correct in 4 out of 5 instances when it showed questionable disproportion and the clinical examination was normal, and in 8 out of 12 cases where there was x-ray evidence but no clinical evidence of disproportion. In 10 out of 12 cases the x-ray evidence was correct in denying disproportion when clinical opinion reported that it existed.

The greatest mortality occurred in a group of 122 cases where there was no evidence, clinical or roentgenological, of disproportion. In this group there were three fetal deaths, 2 of the babies being macerated. The one maternal death was due to toxemia.

JOSEPH T. DANZER, M.D.

Roentgenologic Localization of the Placenta Without Contrast Media. R. Manges Smith. Am. J. Roentgenol. **49:** 750–755, June 1943.

The literature on the subject of placental localization is reviewed and the author discusses his experiences with soft-tissue study of the placenta. In addition to two roentgenograms made in the anteroposterior and lateral positions for bone detail, an additional lateral roentgenogram is made with the soft-tissue technic. These three films usually afford sufficient information to make an accurate diagnosis of the position of the placenta. During the past six years over one thousand such examinations have been made. The placental shadow normally is usually on the ventral side of the fetus and is in continuity with the wall of the uterus. In placenta praevia the extent of shadow which is found in the body of the uterus depends upon the type and degree of placenta praevia. When this is complete, the placental shadow is absent from the upper uterine segment. While it is not usually visible in the lower segment either, because of its concealment by the pelvic bones, the high displacement of the presenting part speaks for its presence there. Diagnosis in these cases, therefore, is dependent upon the absence of a placental shadow from the upper segment of the uterus and displacement of the presenting part from its normal position.

L. W. PAUL, M.D.

GENITO-URINARY TRACT

Layer Formation in Pyelography. Alice Ettinger. Am. J. Roentgenol. **49:** 783–794, June 1943.

As an explanation for certain pyelographic appearances, the author advances the theory that these may be due to layering of the lighter, stagnant urine in the kidney pelvis on top of the denser urine containing contrast medium. An example is the so-called "psoas border sign" in which the medial surface of the kidney pelvis is perfectly straight and parallel to the psoas muscle margin. This configuration is more frequent in cases of hydronephrosis, but may be demonstrated in normal-sized pelves. If observations are carried out over a long enough period of time, a double medial border line of the renal pelvis is visualized. The author explains this on the basis of the layering phenomenon. If the films are made with the patient in various positions, there can be demonstrated a shifting of heavier dye-containing urine within the renal pelvis to the most dependent portion. Layer formation can be demonstrated experimentally if urine is collected before the intravenous injection of the dye and again at the end of intravenous pyelography. If one of these fluids is added carefully to the other, roentgenograms of the mixture will show a distinct difference in density of the two layers and they will remain separated for considerable periods of time.

L. W. PAUL, M.D.

VENOGRAPHY

Use of Venograms for the Localization and Study of Arteriovenous Fistula. James R. Watson, J. M. Lichty, J. M. Hill, and R. B. Miller. Surg., Gynec. & Obst. **76:** 659–664, June 1943.

The use of venography has been principally confined to the study of venous thromboses. Bauer had previously suggested that it might be of value in the study of arteriovenous fistulas, and the authors have confirmed this impression in their paper.

Arteriovenous fistulas produce changes in both the artery and vein, but the latter is the more adversely affected, manifesting varying degrees of hypertrophy and dilatation proximal to or at the level of the fistula. If the valves become incompetent, the adjacent distal segment of the vein may undergo the same changes. However, such dilatation is uncommon, for the arterial blood takes the course of least resistance and passes through the fistula and into the proximal vein.

The authors record 3 cases of arteriovenous fistula of the common femoral vessels in which venography proved to be a reliable means of locating the level of the fistula, as later proved at operation. In each case the vein distal to the fistula was normal. Ligation of the vein distal to the fistula at the time of injury in one case was not followed by the development of varicosities and edema. This was in sharp contrast to the other two cases, in which collateral circulation was through numerous dilated and tortuous superficial veins. The authors believe this suggests that ligation

of the vein distal to the fistula at the time of injury might exert the same beneficial effect on the limb that proximal ligation exerts on the heart.

Venography should be of special value in localizing fistulas when the physical signs are inadequate or even confusing, as when the fistulas are small, multiple, or situated in the upper mediastinum or pelvis. It is also of value in the demonstration of fistulas at or proximal to the roots of extremities, where arteriography is difficult. Venography may be used in conjunction with arteriography when multiple fistulas are suspected. DAVID KIRSH, M.D.

RADIOTHERAPY

Radiation Treatment of Lymphangioma. George W. Holmes and Lloyd E. Hawes. Am. J. Roentgenol. **49:** 799–802, June 1943.

The term lymphangioma includes a considerable variety of slow-growing, usually congenital tumors occurring in the skin and subcutaneous and deep areolar tissues, occasionally invading the muscles of the neck, tongue, lip, and other structures. Three distinct forms have been described: *lymphangioma simplex*, which occurs chiefly in the skin and is composed of an anastomosing network of vessels or spaces of small caliber; *lymphangioma cavernosum*, which consists of a system of closed lymph spaces lined with endothelium; *lymphangioma cysticum*, consisting of a collection of cysts of varying size, lined with flat endothelium and containing lymph. Two other forms are usually added—the verrucous and the cystic hygroma.

The records of 12 cases treated with roentgen rays or radium during the years from 1930 to 1940 are presented. After 1940 radiation treatment was replaced by surgery as a general procedure. In only 2 cases was the diagnosis confirmed by biopsy so that histopathological classification is impossible, but the clinical diagnosis seems correct in a high percentage of the group. The use of biopsy as a means of diagnosing lymphangioma probably should be discouraged, since the findings are often inconclusive and because fatalities not infrequently follow infection.

The results of this review seem to indicate that there is only one form of lymphangioma, the verrucous type of lymphangioma simplex, which responds favorably to irradiation in doses which do not cause permanent injury to normal tissue. All other forms either do not respond at all or require a dose larger than can be given with safety. Infection is a hazard of treatment, particularly in the large tumors of the neck. For this reason the taking of biopsies and the insertion into the tumor of radium in the form of seeds or needles should be discouraged. L. W. PAUL, M.D.

Carcinoma of the Lung, with Freedom from Symptoms for Five Years. N. Puente Duany and W. Figueras Gonzáles. Rev. méd. cubana. **54:** 336–342, April 1943.

Puente Duany and Figueras Gonzáles present a case of carcinoma of the right upper lobe of the lung treated by deep roentgen therapy, with relief of symptoms. The patient was observed for a period of five years, the lung tumor remaining quiescent to the end. Death was attributed to late metastasis.

In the treatment a total of 7,000 r were given, in 20 daily doses through anterior, posterior, and lateral ports 15 × 15 cm., at 50 cm. distance. The factors were 200 kv., 6 ma., filtration 1.0 mm. Al plus 1 mm. Cu, exposure time 30 minutes.

It is unfortunate that no biopsy was done and the type and grade of the tumor were not ascertained.

A. MAYORAL, M.D.

Case of Ewing Tumor of the Right Femur, in the Epiphysis, with Unusual Pathological Fracture. Guillermo Halley. Rev. méd. cubana. **54:** 287–298, March 1943.

A case of Ewing sarcoma in a child of twelve, localized to the epiphysis of the right femur, is reported. The child suffered a spontaneous pathological fracture. Roentgen therapy caused some improvement, but the tumor metastasized to the lung and death occurred fourteen months after the onset of symptoms.

A. MAYORAL, M.D.

Lymphogranulomatosis, with a Secondary Tumor of the Pharynx of Similar Nature. N. Puente Duany. Rev. méd. cubana. **54:** 173–180, February 1943.

Puente Duany reports a case of lymphogranuloma in which the primary lesion was localized to the cervical lymph nodes, with discrete infiltration of the lateral pharyngeal wall. The lesion responded well to deep roentgen therapy, but recurred. A second course of roentgen irradiation effected an apparent cure. Six months later, however, the patient was seen with a large tumor obstructing the nasal passages. This new growth the author suspected to be an epithelioma. Biopsy, however, revealed an invasive and infiltrating lymphogranuloma, which proved to be radioresistant.

The author believes that the roentgen dosage used for the original tumor was not sufficient to cure, although it did relieve the symptoms, and that it may have been the cause of the resistance of the second tumor to irradiation. A. MAYORAL, M.D.

Low-Dosage Irradiation to the Pituitary Gland and Ovaries in Amenorrhea and Dysfunctional Uterine Bleeding: A Long-Term Survey. Leon Reidenberg. Am. J. Obst. & Gynec. **45:** 971–979, June 1943.

The numerous clinical reports on low-dosage irradiation to the pituitary gland and ovaries include only a short follow-up period, one to three years. The present paper is based on a careful follow-up of 136 women who received this type of treatment from three to thirteen years ago. The results indicate that low-dosage irradiation, within the limits employed in these cases, is a helpful and safe agent. No deleterious effect upon the offspring of 54 women who have given birth to 80 children was found.

The technic generally used for ovarian irradiation was as follows: 135 kv., 5 ma., F.S.D. 40 cm., 6 mm. Al filter, size of field 20 × 20 cm. Depending upon the thickness of the abdominal wall, 50 to 90 r (measured in air) were given three times at intervals of one week. The pituitary gland was treated with the same dosage at the same time through a portal 3 × 3 cm., lateral fields being used. Partial relief of amenorrhea by one course of treatment seemingly justifies a second course within three to six months.

The patients to receive this type of radiation were carefully selected. Only those who showed no evidence

of a constitutional debilitating disease, diabetes, or thyroid malfunction were treated. A diagnostic curettage preceded treatment in most instances to eliminate the presence of intra-uterine disease. Women with premenopausal uterine bleeding were not treated. A biologic test was performed to exclude a chance pregnancy.

Thirty-six (or 71 per cent) of 51 patients with secondary amenorrhea of 6 months' to fifteen years' duration were restored to normal menstrual periodicity, and 4 of these conceived within three months after irradiation therapy. The effect on primary amenorrhea was equally interesting. Four patients (18 to 22 years) had never menstruated. One of these began to menstruate spontaneously two years after treatment and continued to menstruate normally for a further follow-up period of four years. In the other 3 treatment was ineffective.

Thirty-seven patients complained of oligomenorrhea, and 29 (or 78 per cent) of these were restored to normal menstrual rhythm. Of this group, 23 complained of sterility. Following irradiation, 17 conceived and carried to term 23 healthy infants.

Seven patients with hypomenorrhea were treated, of whom 6 sought relief of sterility. Four patients (57 per cent) were relieved of the menstrual disorder but only one was relieved of sterility.

Twenty-seven women menstruated cyclically but either excessively or for a prolonged interval. Sixteen (59 per cent) were restored to normal menstrual rhythm. Only one of the 4 patients in this group complaining of sterility was relieved.

Ten patients had totally acyclic menstrual rhythm for periods of six months to four years. None of these complained of sterility. Five were restored to normal menstrual rhythm; 3 were temporarily benefited and two were unaffected. STEPHEN N. TAGER, M.D.

Therapeutic Abortion by X-Rays. Carlos E. Gárciga. Rev. med. cubana **54:** 270–280, March 1943.

The author calls attention to the beneficial effect of castration on cancer of the genital organs in the female. When pregnancy and cancer coexist, the latter will usually be aggravated. Roentgen therapy is recommended not only as a safe abortive, but to cause cessation of menstrual function. From the cases presented, the impression is gained that the usual dose is 2,500 r given in daily doses of 255 r to the right and left ovary alternately. Abortion usually takes place from the twenty-fifth to thirtieth day after the completion of the treatments. The best results are obobtained in early pregnancy. A. MAYORAL, M.D.

New Type of Radium Loading Protective Device. Andrew H. Dowdy, Benjamin DuBilier, and Dean B. Cowie. Am. J. Roentgenol. **49:** 803–810, June 1943.

A new type of radium-loading protective device is described. The old type of protective device had no sides, and the back and bottom were constructed of one inch of lead. The absence of lead sides permitted a direct exposure of the hands and fingers to the radium device. The new device is made with side walls of lead and the lead in the back and bottom has been increased from 1 to 2 inches in thickness. The radium and loaded applicators are manipulated by remote control. The design and the accessory instruments make it possible to shorten greatly the time necessary to load and unload the radium applicators. Charts are included showing the results of measurement tests obtained while unloading and loading different types of radium applicators. The authors believe that with reasonable care the average daily exposure from radium should not exceed 0.005 r in the average hospital. Diagrams and photographs of the device are included. L. W. PAUL, M.D.

EXPERIMENTAL STUDIES

Induction of Leukemia in Mice by Methylcholanthrene and X-Rays. D. P. McEndy, Mary C. Boon, and Jacob Furth. J. Nat. Cancer Inst. **3:** 227–247, December 1942.

Leukemia was produced in mice by repeated percutaneous applications of methylcholanthrene. The animals were killed at intervals, the blood-forming organs were examined microscopically, and transmission experiments were made with suspensions of cells from spleen and lymph nodes.

Numerous transmission experiments made before the eighth week of painting were uniformly negative, although hyperplastic changes were evident in lymphoid tissues. Three cases of leukemia were first demonstrated by transmission experiments. A subsequent microscopic review showed the presence of collections of atypical cells in the splenic pulp and in lymph nodes, while the bone marrow and liver showed no change. The numerous transmission experiments made from histologically definite cases of leukemia failed in only 1 of 46 injected mice. Of the tests used to determine the presence of leukemia, the gross examination is the least reliable, the microscopic examination next in order, and the inoculation experiments are the most decisive.

The type of leukemia produced was lymphoid or atypical, with the exception of a few myeloid or monocytic leukemias. Evidence is presented suggesting that the atypical cells originate in lymphoid tissues.

The onset of induced leukemia is sudden when judged by the criteria studied.

In some of the experiments the mice were irradiated either before or after painting with methylcholanthrene. The following factors were used: 140 kv., 5 ma., 30 cm. T.S.D., with an inherent filter of 1 mm. aluminum. Under these conditions the output of the machine was 100 r in 0.7 minute. All irradiated mice received 300 r. The incidence of leukemia was slightly higher among the x-rayed and painted mice than among the mice painted but not x-rayed.

A preliminary study of blood smears indicates that the majority of induced leukemias are accompanied by specific blood changes recognizable at least two weeks before the death of the animal.

Effect of Heparinization on Experimental Post-Irradiation Tissue Changes in the Lung: Preliminary Study. Floyd Boys and Ivor D. Harris. Am. J. Roentgenol. **50:** 1–7, July 1943.

Young adult white Belgian rabbits were treated with 200 kv. irradiation over the entire thorax. Each animal received a total of either 4,200 or 4,900 r. The period of roentgen irradiation was fourteen days, the treatment being given on alternate days. Control and experimental groups were used. The control group was

given irradiation alone, and the experimental group was heparinized with liquaemin in conjunction with irradiation.

These experiments seem to indicate that heparin has a definite effect on the inflammatory process in the lung parenchyma. The inflammation which follows roentgen irradiation damage to the lungs of rabbits is somewhat less extensive when heparin is administered than without heparin, and later changes (pulmonary fibrosis and pleural adhesion formation) are greatly diminished.

Since heparin is a dangerous drug, much more extensive work covering other types of inflammation is required before it will be possible to make practical use of the phenomenon suggested by the results here obtained. However, these experiments suggest a new technic for the measurement of the effect of roentgen irradiation on various tissues, particularly in the field of malignant tumors. It is still apparently not established whether the effect of roentgen irradiation in checking malignant growth is entirely a direct destruction of the cancer cell or whether this destruction is much or little enhanced by the accompanying fibrosis. If fibrosis can be markedly diminished in the experimental animal with the use of heparin, there may be at hand a new biological method for measuring direct roentgen irradiation effect on cells in the living body.

CLARENCE E. WEAVER, M.D.